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CURVES FOR WINDING MAGNETS.

We print elsewhere the first of two sets of curves designed to assist in selecting the proper size of wire for winding magnets. Owing to conflicting conditions as to the resistance, number of turns and heating limit, the computations otherwise necessary for this purpose may be quite extensive and are laborious in any event. By means, however, of the tables constructed by Mr. Wood, each trial merely necessitates a glance at the table, and besides the labor being thereby reduced to a minimum, the result is apt to approach much closer to the best condition. The plan of using several different scales in constructing each chart is one that might be more often employed in similar work, as through it measurements from every point of the curve may be taken with almost equal accuracy. Another feature of value is the ease with which a temperature correction is applied, it being only necessary to change the value of the actual ampere-turns to conform to the working temperature fixed upon, and apply the new value to the curve.

GENERAL ELECTRIC AND WESTINGHOUSE.

During the past week the proposed arrangement between the General Electric and Westinghouse companies in regard to patents seems to have "struck a snag." At a meeting of the directors of the former company during the week, no action was taken in the matter, and now it is said that the joint committee charged with the details of the arrangement has been relieved of its duties for the present. As to the nature of the difficulty encountered, there are various rumors, none of which can be verified. According to one, director T. Jefferson Coolidge, of the General Electric Company, objected to the terms of the arrangement arrived at, which was equivalent to a veto. Another report is that the opposition of the executive officers of the two companies to the project finally had effect with the banking interests that favored it. A Wall street rumor cynically ascribes the interruption to the unfavorable condition of the stock market, and predicts that the same measure will soon be brought forward again for stock jobbing purposes. Finally, it is said that the cause of the difficulty was a disagreement as to the valuation of certain patents, and this appears to be the most plausible reason. All of the more valuable patents owned by either company are now questioned by one or the other, and it will naturally be no simple matter to arrive at an amicable agreement under these circumstances. Even should the validity of a patent be conceded, its valuation would be subject to the widest differences of opinion. The Tesla rotary field patents would appear, for example, to offer serious obstacles to an agreement, for it seems probable that the Westinghouse Company would insist upon the recognition of their validity, an acceptance of which condition would place the General Electric Company at a decided disadvantage.

ELECTRICAL RESONANCE.

The paper read by Messrs. Houston and Kennelly at last Wednesday's meeting of the Institute on "Resonance in Alternating Current Lines" is a valuable contribution to the *Transactions*, and admirably supplements Dr. Pupin's work on the same subject. While the mathematics are necessarily of such a character as to appeal to but few, happily the understanding of but a small portion of the paper is affected by this. The graphical method given for solving the equations, together with the clear and simple explanations, enable the general expression to be applied to specific cases without the necessity of being fully acquainted with its deduction or with the special mathematics involved. The conclusions of the authors are of particular interest in showing the relation when there is resonance

between the line losses and the amount of power delivered. As the phenomenon of resonance is due to displacement of phases it was natural to suppose that when present the power factor would be decreased, and this the paper very conclusively shows, though it is pointed out that a preponderating capacity may produce a limited increase in efficiency by reducing the generator capacity. It is also stated that, theoretically, benefit might be derived from resonance were it possible to tune receptive devices, such as a transformer, in harmony with the line, but the inference to be drawn from the context is that practically this cannot be obtained. While, therefore, resonance offers no advantages for power work and possesses distinct disadvantages on account of the rise of voltage incident to it, the case appears to be different with respect to telegraphic and telephonic transmission. Here the question of line loss cuts no appreciable figure, and the rise of voltage would probably reach no serious proportions. The conclusions of the paper consequently do not seem to apply to these cases, while on the other hand the claim has been authoritatively made that resonance can be made to play an important part in this connection. We hope that the question may soon be put to a definite test on a long distance telephone line. By distributing in stations along its length the necessary apparatus to bring the line to resonance, a satisfactory experiment should be possible, and the importance of the issue at stake would seem to be sufficient to warrant the necessary outlay.

UNDERWRITERS' RULES.

The Institute paper of Prof. Anthony on "Underwriters' Rules" differed from the usual character of papers written by engineers on that subject, in that it criticised a rule for lack of stringency, and it is not creditable to the New York Board of Fire Underwriters that the necessity for such a course should have arisen. It is also significant that the blunder of this board was made in a departure from the code of rules formulated by the Underwriters' National Electric Association. We have before referred to the practice of some of the underwriters' associations in making whimsical or unwarranted changes or additions to this carefully prepared set of rules, and the present case is probably typical of the value of most of the supposed improvements thus introduced. Of all underwriters bodies, the New York Board has in the past shown itself to be the least qualified to take any step involving technical judgment, and it is not surprising, therefore, that the absurd rule criticised by Prof. Anthony should have originated with it. The discussion which followed the paper was quite at variance with the spirit of Prof. Anthony's criticism, for it consisted of little more than a denunciation of underwriters' associations, rules and inspectors in general. About the only specific criticism was directed at the rule permitting only one wire of a circuit in iron-armored conduits, which no longer exists; while one of the speakers denounced the underwriters for not keeping up to the time with their rules, another inveighed against them for the several recent revisions which were made for this very purpose. It is natural that an antagonism should exist between the underwriters and those who have to do with installing wires and apparatus; the main desire of the latter is to do work in as economical a manner as possible, while the former are inclined to lay down requirements with a view to an excess of security against fire hazard, the expense entailed being a secondary matter. Instead, however, of general denunciation, which will merely make matters worse, criticism of underwriters' rules should be specific, as in the paper referred to, which would result in making a tangible issue toward which the attention of the electrical interests could then be directed with a view to correcting the alleged evil, should it be proved to really exist. We are glad to learn that there is a movement on foot for a conference between the Underwriters' National Electric Association and the several national electrical bodies, the object being to arrive at a mutual understanding in regard to a code of insurance rules. This should serve a good purpose; for if there is not unanimity in the views of the two interests, and it is improbable there will be, the differences will be narrowed down to specific points and the battle can afterwards be waged on these alone and not against the entire code. This offers the most satisfactory solution of the difficulty, for the adoption of a rival set of rules by the electrical interests would merely accentuate the trouble. It would also be illogical for one interest to thus lay down a code of rules for the guidance of an antagonistic interest, particularly when the latter has immense sums of money at stake in the matter, and, above all, is in such a position that it can with impunity completely ignore the existence of any other rules than its own, which course would undoubtedly be adopted.

The Street Railway Gazette.

The *Street Railway Gazette*, with all its assets, has been purchased by Mr. W. J. Johnston, and will hereafter be issued each week from 253 Broadway, New York. The *Gazette*, which is the only weekly street railway journal in the world, was established in 1886, and for the first six years was published monthly. Since 1892 it has been issued every week. Mr. Clarence E. Stump, general manager of the paper, and Mr. J. W. Dickerson, the editor, will still be connected with it under the new management. As a result of the change in ownership some modifications will be made in the paper. The size of the page will be slightly reduced and the number of pages considerably increased. Careful attention will be bestowed upon the reading contents, in order to render them of the greatest every-day value to the audience addressed. The articles will be by practical men, for practical men, and while technically accurate will be written in plain and simple language. More illustrations will be used than formerly, and the effort will be to make the paper in every way a worthy representative of the activity and enterprise and progressiveness characteristic of the street railway business. The co-operation and assistance of both street railway officers and employees to this end will be highly appreciated. Items of news, articles for publication, and suggestions as to directions in which the *Gazette* can be improved will always be welcome; so will names of probable subscribers and lists of new subscriptions.

Mr. A. P. Trotter.

Mr. A. P. Trotter has recently resigned the editorship of the London *Electrician*, over whose pages he has so ably presided for several years. Electrical journalism suffers a real loss in the retirement of Mr. Trotter who, in addition to his thorough scientific and professional requirements, possesses a trenchant literary style and independent habit of thought that won favor with readers and gave a distinctive and enviable character to the editorial pages of the *Electrician*. Mr. Trotter, we learn, will hereafter devote his whole time to his mechanical and electrical consulting practice, including photometric testing. Being now able to give more attention to work in his laboratory, we may perhaps expect from Mr. Trotter's pen further valuable contributions on photometry and illumination, like his notable paper on the "Distribution and Measurement of Illumination," read several years ago before the Institute of Civil Engineers, and his more recent paper on "Dioptric Glass Shades."

Subway Explosions.

Referring to the recent subway explosions in London, the *Electrician* hazards an explanation. We have, it says, a cathode separated by a film of electrolyte from a larger supply in damp wood, connected with an extensive vat in the form of the earth. There is then a continuous flow of dilute solution of salt to the cathode. Soda is formed, and as the water is scarce, sodium. This process, going on by the month or year, can accumulate considerable quantities of soda and sodium, and, of course, carbonates are also formed. As to how the sodium can light the gas, the catastrophe can happen in many ways. If you have 100 volts or more on a circuit, which, owing to the gradual accumulation of caustic, has a fairly low resistance, you may easily have a high enough temperature to fire a piece of sodium suddenly exposed to the air by a flake of protecting hydrate or oxide falling off. That the sodium is in lumps shows it must have been hot at least once, as it would not otherwise be run together unless it aggregates in some mysterious way like flints in chalk. Again, a piece falling off into a wet culvert might easily fire. In many cases potassium was also present. Potassium fires more easily than sodium. The metals also alloy and form a liquid which will light even without being thrown into the water. This alloy being liquid, a coating cannot adhere to and protect it. When a drop is spilled on the table, if it does not catch fire at the time, it will if a duster is used to wipe it away.

The American Institute of Electrical Engineers.

The regular monthly meeting of the American Institute on April 17 was opened by President Houston with a feeling tribute to the memory of the late treasurer of the Institute, Mr. Geo. M. Phelps. Mr. A. E. Kennelly then read a paper on "Resonance in Alternating Current Lines," prepared by himself and Mr. E. J. Houston.

The objects of the paper were stated to be to present the formula expressing the variation of electric current and pressure in an alternating current circuit under the most general conditions, and in its simplest form; to present calculations for the pressure and current in any alternating current circuit, by a graphical method; to investigate the effects of static capacity in an alternating current circuit, and to investigate the effects of capacity and inductance on the delivery of energy at the distant end of a circuit. General formulæ are deduced for the E. M. F. and current strength at any point of an alternating line, expressed in terms of the resistance, inductance, capacity, leakage and the initial and terminal E. M. F. and current strength, hyperbolic functions being employed. Graphical methods of determining the vector terms of the equation are given, and a chart is included enabling the numerical value of the hyperbolic functions to be arrived at by inspection.

Examples are worked out with data favorable to the development of resonance, with a view to disproving the claim that has been made as to the economy offered by resonant lines for the transmission of power. It is shown that while a resonant line may deliver twice as much alternating current with the same $C^2 R$ loss as a continuous current line, owing to difference of phase between the E. M. F. and current, much less energy will be delivered in the former case with the same line loss. The conclusions of the authors are as follows:

(1). The combined effect of capacity and inductance is to produce a tendency to resonance. (2). The tendency to resonance is favored by high frequency, high insulation, high inductance, high capacity, and high conductance. (3). When the line is free at the distant end, the resonant effects are more pronounced at that end than at the generator. (4). The determining factor for the production of resonance is the angle of the vector geometric mean of the conductor impedance and dielectric admittance, and rapidly increases with the same. (5). The complete wave-length in a resonant line is 2π times the length, in which the reactances of the inductance and the capacity are equal, the maximum difference of pressure or current strength being exhibited in one quarter of this wave-length. (6). When resonance occurs, the current and pressure in the circuit are not in phase except at their maximum and minimum values, *i. e.*, at the crests and troughs of the waves. (7). In resonant circuits, the lag of the pressure and current is 90 degrees between any successive pair of maximum and minimum values. (8). In ordinary lines, worked sinusoidally at ordinary frequencies, resonant effects are practically negligible. (9). Prominent upper harmonics in the E. M. F. of the generator may sometimes give rise to appreciable resonant effects, although the resonance to the fundamental frequency may be inappreciable. (10). A certain amount of capacity tends to increase the plant efficiency of the generator, and is, therefore, economical, but marked resonance in a line not only ceases to be economical, but is actually wasteful. (11). Although, on a large scale, less energy can be delivered at the distant end of a powerfully resonant line, than on a non-resonant line, yet a greater current strength can in some cases be delivered over a powerfully resonant line.

In the discussion that followed Prof. Pupin said that Prof. Kirchoff in 1867 first directed attention to the subject just treated. The analogy of a stretched string to the conditions of resonance was dwelt on, it being stated that the analogy was a true and not merely illustrative one. Prof. Pupin, while accepting the conclusions of the author as to the non-applicability of resonant lines to the transmission of large amounts of energy, maintained that for telephonic and submarine cable purpose the employment of the resonant principle was of value.

Prof. A. G. Webster referred to the thorough manner in which Prof. Oliver Heaviside had treated the general question involving capacity and inductance, and paid a high tribute to his intellectual power. The chart of hyperbolic functions was criticised on the score of complexity and a substitute offered; the paper was also declared deficient through not properly considering terminal conditions. In reply Mr. Kennelly stated that the chart in the paper was constructed for the exact requirements implied in its proposed use, which condition was not satisfied by the chart suggested by Dr. Webster. He also showed that the general equation given in the paper did properly consider the necessary terminal condition.

Prof. W. A. Anthony then read his paper on "Underwriters' Rules," which severely criticised the approval by the New York Board of Fire Underwriters of a certain insulated conductor as a substitute for conductors in tubing. The conductor referred to consists of a standard insulated wire with its covering of rubber and braid, having woven upon it two additional coverings of extra heavy braid. This additional covering, which is tightly woven on, and from which the wire can no more be removed than from its original covering of rubber and braid, the maker, said Prof. Anthony, by an extraordinary stretch of language, calls a tube, and claims for it the advantages of the conduit tube prescribed in the insurance rules, which unwarranted claim has been accepted and approved by the New York Board of Fire Underwriters.

The discussion which followed was participated in by Messrs. Hammer, Leonard, Woodbury, Jenks, Holmes, Mailloux, Ayer and Hamblet. The opinions expressed principally related to the manner in which insurance rules were enforced, though some of the speakers roundly denounced insurance rules, underwriters and inspectors in general. In the course of the discussion it was announced that a movement is on foot to bring about a meeting of official representatives of the American Institute of Electrical Engineers, the Underwriters National Electric Association, the National Electric Light Association and other bodies interested in insurance inspection, the object being to arrive at an agreement as to a code of rules.

At the council meeting in the afternoon Mr. Geo. A. Hamilton was elected treasurer for the unexpired term of the late Mr. Geo. M. Phelps, and a committee was appointed to draft resolutions commemorative of the services of the latter to the Institute, which were read at the evening meeting as follows:

"The Council of the American Institute of Electrical Engineers, desiring to express its sense of the loss to the Institute in the death of George May Phelps: at its meeting held Wednesday afternoon, April 17, 1895, at the Institute headquarters, appointed a special committee of three to draft suitable resolutions which the undersigned as committee respectfully present herewith.

"Resolved: That in the death of George May Phelps, the council has suffered the loss of an energetic, faithful, and capable member, and the Institute a most efficient officer; one who was constantly striving to uphold the standard of its work, one who was ever watchful of its welfare. In his disinterested efforts to serve the Institute, he brought to bear upon its deliberations his keen perceptions, intellectual ability, and eminent force of character.

"Resolved: That a copy of this resolution be suitably engrossed and framed and presented to Mrs. George W. Graham, his daughter, and the sole surviving member of his family."

Science and Mathematics.

In a recent address delivered by Prof. H. S. Carhart on "The Educational and Industrial Value of Science," he refers to the relations between science and mathematics as follows:

"Mathematics furnishes a training in the relations of abstract number, and in the manipulation of symbols invented to facilitate operations expressing the relations between related quantities. It is not only a valuable agency in mental development, but it is a powerful instrument for the investigation of phenomena in those branches of science to which applied mathematics is indispensable. Science has more to do than either language or mathematics with objective phenomena. The student of science soon finds that he has a new set of relationships with which to deal. He may be familiar with mathematical theorems and solutions, but his first difficulty is to see the points of attachment of mathematics to the facts of physical science. He is armed with a weapon of most modern design and exquisite workmanship, and he has possibly obtained some skill in target practice, but he has no eye for game. He may be too short-sighted to see that there is any game even."

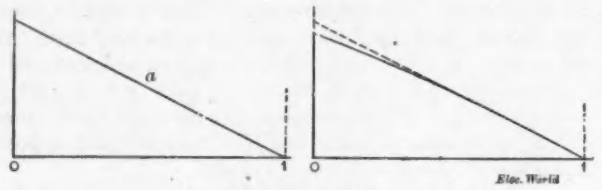
Press Telegraph Messages.

The London *Electrician* says that so heavy is telegraphic press work at night time that the most highly paid operators and the most costly appliances have to be resorted to in order to cope with it. Night work is always more expensive than day work, and it is probably a fact that press messages cost more at night than in the day time, although transmitted at a cheaper rate.

Contribution to a Theory of Synchronous Induction Motors.

BY ALEXANDER ROTHERT.

The object of the present article is not to put forth any novel ideas, but rather to explain, in a clear and general way, the properties of simple alternating and polyphase motors, and particularly to elucidate the operation of a simple alternating motor in plain



FIGS. 1 AND 2.

terms. For this purpose, we have a very convenient method, which shows the properties of these motors remarkably well: namely, the diagram of torque as dependent upon speed and slip.

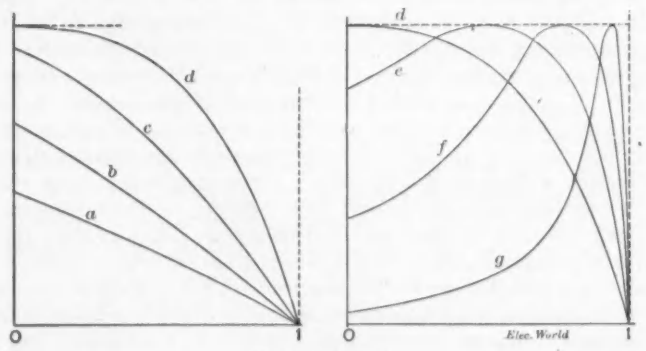
Let us turn at first to the more simple case, that of the polyphase motor. We must make the supposition, that the field system generates an approximately constant rotary field, whose intensity, within practical limits, depends only upon the working potential, the latter being taken as constant.

For the sake of simplicity, let us take the theoretical case in which the closed circuited armature has no self inductance; *i. e.*, that all the lines of force which pass through the armature also traverse the field system. The electromotive force generated in the armature will be (as in a continuous current dynamo) proportional to the relative velocity of the field and armature, that is to say, proportional to the slip. In accordance with Ohm's law, the armature current will accordingly be directly proportional to the slip. The torque is equal to the product of the armature current and the intensity of the rotary field, and, therefore, with a constant rotary field, proportional to the armature current and, consequently, to the slip also.

The result is shown graphically in Fig. 1. The abscissa eare the revolutions of the motor from 0 to the speed of synchronism, which is called 1, and the ordinates are the corresponding torques. In accordance with the above, the straight line *a* shows the dependence of the torque upon the speed, as, with synchronism (slip = 0), the torque is zero, and with the motor at rest (slip=1), the torque becomes a maximum.

A motor approaching this theoretical case would be one whose closed armature winding possesses large resistance in proportion to its self inductance; that is, a motor with very little winding space in its armature. Such a motor would naturally be worthless in practice, on account of too much slip, low efficiency and large size for a given power, but it would start very well, because when at rest the torque is a maximum.

The larger the self inductance becomes in proportion to the resistance, the more bent does the straight line become (Fig. 2), because



FIGS. 3 AND 4.

there arises a shifting of phase between the current and E. M. F. in the armature, which on the one hand weakens the attraction between the rotary field and the armature current, while on the other hand the current itself diminishes.

The self inductance of the armature is limited by the scattering of the lines of force induced in it by the armature current, and is therefore greater, the greater the number of such lines which are closed upon themselves without passing through the iron of the field magnets. This leakage will, in general, increase with a larger number of ampere turns in the armature (that is, with greater winding space) and with increasing magnetic saturation of the air space.

If we start with a given number of turns in the armature, and let the resistance diminish successively, that is, have the winding space increase, the diagrams will appear as in Fig. 3. The curves will differ more and more from a straight line, while the torque as well as the power of the motor will increase considerably, but only to a certain maximum. From this point the maximum value of the torque remains constant*; but the character of the curve changes as the torque at starting diminishes again, and the more, the greater the winding space—that is, the smaller the armature resistance becomes. This relation is shown by Fig. 4.

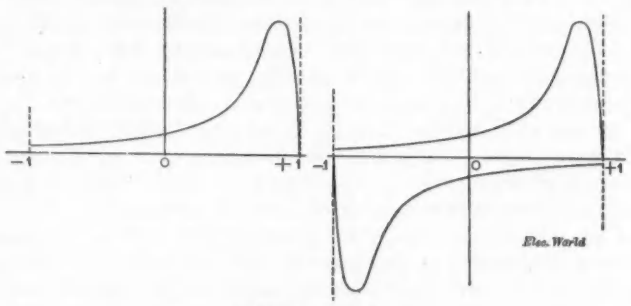
A motor corresponding to curve *g* would start badly, eventually not at all, but on the other hand has a much more constant speed, as the torque reaches its maximum before the slip has grown at all large. This amount of slip may be reduced at pleasure, but naturally, as Fig. 4 teaches, only at the cost of the starting torque.

As can be seen by these curves, the designer is entirely able to make non-synchronous rotary current and polyphase motors to suit any particular case.

A motor may be required, for instance, to drive a crane, which shall start with great power, while constancy of speed is not important; or, on the other hand, a motor with as constant a speed as possible, but which starts with no load.

Between these two extremes, all sorts of intermediate cases may naturally arise.

We possess, however, a means by which both important properties may be combined. This consists in switching non-inductive resistances into the armature circuit at starting, by which we obtain the curve *d* for the start, instead of curve *g*. After the motor is running, the resistances are gradually cut out. This method also possesses the advantage of avoiding excessive currents at starting, but unfortunately it involves the use of collecting rings and



FIGS. 5 AND 6.

brushes. Instead of switching in resistances, certain parts of the winding can be made to oppose others and thus reduce the effective number of turns while keeping the resistance constant. The same object would be attained by switching condensers into the armature circuit and so neutralizing the self induction, but it would be difficult to employ this method in practice. All these methods presuppose that a closed circuited armature, wound with wire, is used, and not a so called "closed ring" armature consisting, as is well known, of rods which at either end of the armature are connected with each other by a conducting ring.

Before passing to simple alternating motors, the following case must be disposed of: Let us imagine that the armature revolves in a direction opposite to the movement of the rotary field, and let the appropriate diagram be drawn. Naturally, work must be expended to turn the armature, for, according to Fig. 5, the torque opposes the motion and is therefore negative.

The alternating current produces in the field magnets of a simple alternating motor a pulsating field, which for simplicity's sake may be taken as sinusoidal. But a sinusoidal pulsating field may be resolved into two rotary fields of equal period, which revolve in opposite directions.

We can now return to our former line of thought. Each of these two rotary fields induces in the closed circuited armature currents

*Blondel has shown this analytically in his able treatise: "Notes sur la Theorie Elementaire des Appareils à Champ Tournant," in *La Lumière Electrique*, 1893, vol. 50. It also follows from the graphical representation of Heyland in the *Elektrotechnische Zeitschrift*, 1894, No. 41.

of different periods, which again produce two torques, one of which, considered with reference to the direction of motion, is positive, the other negative. Let us show these torques in the diagram, Fig. 6. On the right of the axis of ordinates are drawn the torques for direct (clockwise) motion and on the left those for the inverse rotation of the armature. The two curves must naturally be entirely congruent, as the armature is a system symmetrical to both rotary fields. It follows then directly, that at rest the motor produces no torque, as the two single values cancel each other, and when set in motion can turn in either direction at pleasure, in which respect it acts very nearly like a polyphase motor. It also follows from the diagram that only closed circuited armatures with large winding space can and should be used here, for if an armature were taken, whose torque curve looked like Fig. 3c, for instance, a diagram like Fig. 7 would be obtained, which, as is easily seen, gives only a negative torque.

The drawbacks of the simple alternating motor as compared with the polyphase motor can also be directly derived from the diagram: The former, when running unloaded, has a greater slip than the polyphase motor, since its torque is negative when running synchronously; there is also much more loss of energy in the armature of the single phase motor, because the rotary field which is opposed to the direction of revolution works inductively and causes losses of energy in the form of currents of great frequency (equal to twice the frequency of the alternating current). Moreover, these currents influence the torque injuriously.

The motor will work more favorably, the smaller the slip is made, because the negative torque is thereby reduced. A limit to this diminution of the slip is sometimes fixed by the requirement that the motor shall start like a polyphase motor. A further important drawback of the simple alternating motor results from the fact that

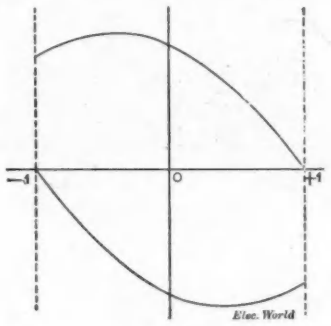


FIG. 7.

the pulsating field, which we have imagined resolved into two rotary fields, is twice as strong as its two components, as the following consideration easily shows:

The two oppositely turning rotary fields will, at two points 180 degrees apart, combine to form the amplitude of the alternating current field, while they will cancel each other at two points distant 90 degrees from the former two; each of the two rotary fields has, therefore, only half the intensity of the alternating current field. In consequence, a motor with a single current will require twice as strong a field as with polyphase currents to produce the same torque with the same slip, the same working E. M. F. (with polyphase currents, the E. M. F. of one current) and the same power being presupposed. The iron of the simple alternating motor would, therefore, be much more strongly saturated, or, as this is not generally customary, the motor would have to be considerably larger.

Although the slip can be reduced by further enlargement of the winding space in the armature, the torque cannot be increased, and so the simple alternating motor will always be decidedly larger than a corresponding polyphase motor, and will at the same time have about double the hysteresis loss. Moreover, in consequence of the double strength of field for the same torque, the shifting of phase will be much greater, as has been fully proved by experience.

As has been seen, the operations in a simple alternating motor, which are really somewhat complicated, are here derived in an elementary and, at the same time, a very striking manner; and the method of the diagram of torques used here may be recommended in all cases where it is desirable to elucidate the properties of simple and polyphase alternating current motors in an easily understood way, without much mathematics. And to the designer it also suggests a simple method of calculating the dimensions of closed circuited armatures for simple alternating motors.

The Galvanometer in Practice.

BY LOUIS DENTON BLISS.

Electrical measuring and testing instruments of all classes in their commercial form, while easily understood and intelligently handled by an expert, are usually so complicated in construction, with their numerous concealed wires and indefinable circuits, that in the hands of the student who has only acquired an elementary knowledge of the science, they appear very complex and exceedingly difficult to handle.

The essential parts of a galvanometer are three things, namely: a piece of wire, a magnetized needle, and a silk thread. All the other

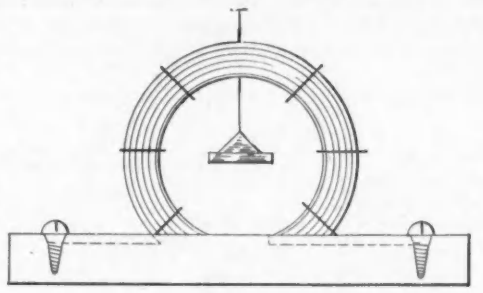


FIG. 1.

material so frequently used is simply for the purpose of rendering the instrument more sensitive in its operation, more nearly "dead beat," and to further improve its appearance generally, in order that a purchaser may be induced to feel that he is getting a little nearer the worth of his money. An instrument may be constructed at a cost not exceeding 20 cents, which, in connection with a slide meter Wheatstone bridge, will accurately indicate, within a half centimetre, the unknown resistance.

Fig. 1 illustrates the general appearance of the instrument. Fifteen cents' worth of cotton covered magnet wire, wound in a coil, as indicated, and mounted upon a block of wood, constitute the main parts of the instrument. A brass screw at each side of the block serves as a terminal for each end of the coil, and also as a binding post. Next, a piece of a watch spring, not over five-eighths of an inch in length, which can be obtained from any jeweler, should be magnetized by stroking it with one pole of a permanent or electromagnet. Heating it red hot and cooling it in mercury before magnetizing will render its retentivity greater.

This needle should now be glued to a fibre drawn from a short piece of silk thread. The other end of the fibre should be attached in a similar manner to a piece of brass wire, which has previously been carefully forced downward between the wires to about the centre of the coil. A triangular piece of very thin paper glued to the side of the needle, as shown in the cut, will render this instrument partially "dead beat."

A thin disc of mica, just small enough to fit snugly into the coil on each side, serves to keep off the air, and at the same time prevents the needle from turning all the way around, which would

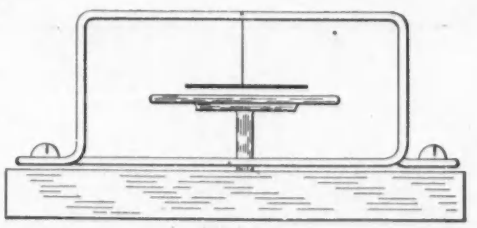


FIG. 2.

tend to break off the fibre by the continual twirling of the needle. The galvanometer is now complete, and will be found exceedingly useful for detecting very small currents.

A simple detector galvanometer may be made at a cost for materials of not more than 10 cents, and is capable of indicating the presence and direction of comparatively small currents. Fig. 2 illustrates this instrument, which consists of four turns of No. 12 uninsulated magnet wire, the convolutions resting parallel to each other but not quite touching. The terminals of the wire are attached by means of two brass screws (which serve also as binding posts) to a small block of wood. A common steel sewing needle, magnetized and suspended in the same manner as described in the

previous and more sensitive instrument, serves to indicate the deflection. A paper dial mounted on a little wooden table directly under the needle shows the proportionate intensity of different currents.

A tangent galvanometer can be constructed at practically no cost whatever. A piece of No. 12 scrap wire, 18 inches long, bent into a circle, as shown in Fig. 3, makes an excellent ampere meter when a needle is used of the same size as that in Fig. 1. A long pointer, consisting of a wisp of straw, when glued to the needle, serves to indicate, in amperes, the strength of the current passing, reading directly on a scale laid off in the tangent of a circle. The only objection to this instrument would be that it is not "dead beat," but as far as accuracy of indication is concerned it would compare favorably with a $25 ammeter.

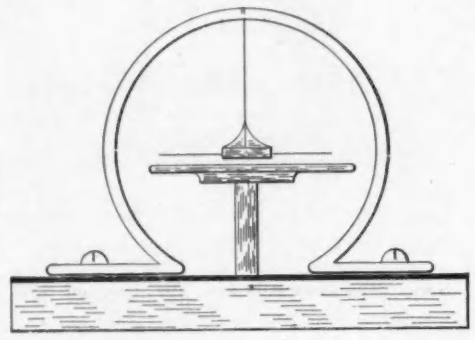


Fig. 3.

A Wheatstone bridge is very easily constructed out of a piece of board three inches wide, seven-eighths of an inch thick, and 42 inches long. A binding post at one end has fastened under its base a piece of No. 16 German silver wire, 39¼ inches long (one metre), which is also attached at the other end in a similar manner. A binding post placed in the centre of the board, a little to one side, completes our bridge, as shown in Fig. 4. The board should be marked off, under the German silver wire, into 100 equal parts, or centimetres. The galvanometer shown in Fig. 1, when used with this bridge, gives excellent results.

Let us suppose that we have an unknown resistance which we desire to measure. We will attach one terminal to the binding post *A* and the other to the top of the binding post *C*. We must then insert a known resistance between *A* and *B*, which, for convenience, we will presume to be 100 ohms. To the binding posts *B* and *C* we will also attach the terminals of a battery consisting of two or three cells of the Leclanche or other similar type. One wire

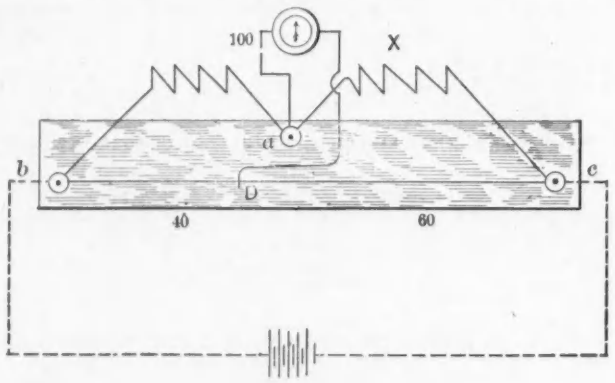


Fig. 4.

will also be connected from the binding post *A* to the galvanometer, and another from the other side of the galvanometer leading down, with a bare terminal which may be touched at any desired point upon the German silver wire extending from *B* to *C*. The current leaving the battery and entering the bridge at *B* finds two paths which it may take, one through the German silver resistance wire, the other through the hundred ohm coil and unknown resistance. The proportion of current which will flow through the German silver wire will be, of course, greater than that which will take the path through the resistance coils on the other side of the bridge.

If the resistance of the portion of wire between *B* and *D* bears the same relation to the portion between *D* and *C* that the hundred ohm coil does to the unknown resistance coil, no current will flow across the bridge through the galvanometer from *A* to *D*. One important fact to be noticed in this connection is that it is not at all necessary to know the resistance of the German silver wire extending from *B* to *C*, as the unknown resistance may be determined wholly upon the ratio which one side, *B*, *D*, bears to the other, *D*, *C*.

If the galvanometer wire, when resting upon the German silver wire, be moved in either direction, so as to disturb this ratio, the balance would no longer be maintained, and the current would flow, thus deflecting the needle one way or the other, according to the direction in which the galvanometer wire was moved.

Now, if the point on the bridge necessary to bring the galvanometer needle to zero measures 40 centimetres from *B* to *D*, and 60 centimetres from *D* to *C*, we would have the simple algebraic formula to find the unknown resistance, which would be 40 : 60 :: 100 : x, from which we find the unknown number to be 150 ohms.

Supposing we desire to find the resistance of the galvanometer itself—in other words, make it indicate its own resistance without the use of another galvanometer; it is only necessary to place it in the position formerly occupied by the unknown resistance coil, as in Fig. 5, between *A* and *C*, and connect a wire in short circuit directly from *A* to *B*.

A large amount of additional resistance of any kind must also be looped in series with the galvanometer and embraced in the circuit from *A* to *C*. If, now, the battery circuit be attached the greater portion of the current will, of course, come through the German silver wire from *B* to *C*. A slight portion will be deflected through the hundred ohm coil, galvanometer, and other resistance which now occupy the space between *B* and *C*.

The needle will, of course, be deflected somewhat. By touching

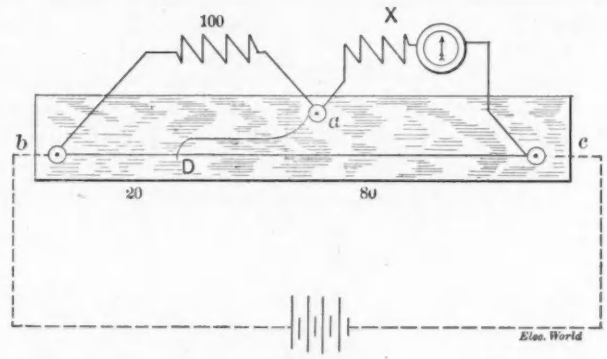


Fig. 5.

the wire *D* to the German silver wire, a portion of the current having passed the hundred ohm coil, and finding in its path beyond that point the increased resistance of the galvanometer, and the other coil, will be inclined to leave the binding post *A* and take the path of the lowest resistance from *D* to *C*. This would allow a little less current to pass through the galvanometer, permitting the needle, already deflected, to partially recover itself.

When the ratio which *B D* bears to *D C* is the same as 100 bears to the unknown resistance, no deflection of the galvanometer needle will be apparent, indicating that a balance has been attained and no current is passing from *A* to *D*, when the wire leading from *A* touches the German silver wire at the point *D*.

If, now, we find that *B D* measures 20 centimetres, and *D C* measures 80, we have the equation 20 : 80 :: 100: x, from which we find the galvanometer and other resistance coil to measure 400 ohms. By separately measuring the extra resistance, as in Fig. 4, and deducting it from the 400 ohms, we would be enabled to tell the true resistance of the galvanometer.

The Three-Wire System.

At the recent meeting of the English Institution of Electrical Engineers, one of the speakers, says *Lightning*, introduced an unexpected and welcome variation of the monotony of the debate by the discovery of an entirely new advantage in the three-wire system. It was so convenient, he said, to have your lights on separate circuits, so that you could extinguish half of them. This reminds *Lightning* of a three-wire installation it once heard of, in which the middle wire was put down double the cross section of either of the other two, because, said the contractor, *it had to carry the current on both sides.*

Curves for Winding Magnets—I.

BY HARRISON H. WOOD.

In determining the shunt windings of a dynamo or motor many independent and often conflicting requirements have to be met. The field coils must not become too hot; the energy lost must not be so great as to impair the efficiency of the machine; the windings frequently have to be confined to a limited space; the weight of copper must be kept as low as possible. Usually there is but one size of wire that will most nearly satisfy all these conditions, and the problem is to determine from the given data this size of wire.

The various quantities that enter into the computation are the ampere turns necessary to set up the desired magnetization, the impressed electromotive force, the length of wire or mean length of one turn, the number of turns, the current, the resistance, and the available space for winding. These are all interdependent, and from the relations that exist between them various formulæ have been derived that will give the diameter of wire that will have to be used. To satisfy all the requirements, however, may necessitate several trials, and as the formulæ are complicated, this is a laborious process.

When the relation that exists between variable quantities can be expressed by means of an equation, however simple the equation may be, it is often a great help to represent the relation graphically on cross section paper. This is especially true in regard to the above quantities, and the writer has endeavored in the following curves to represent in the most useful and comprehensive manner the complicated relations that exist between them.

The curves do not supply any new methods for dynamo design, but they give almost at a glance what would otherwise take a large amount of labor to accomplish, and by means of them the designer can see just how the variation of one quantity will affect all the others; and with whatever quantities he may have given the others can be determined by simple inspection. If the assumptions are such as to make the choice of a satisfactory winding impossible, he can see at a glance just what alterations to make in the original assumptions in order to produce the desired result.

Two sets of curves have been constructed, each set consisting of a curve for each size of wire from No. 4 to No. 36. It has been found convenient to use two separate cuts for each set, Fig. 1 containing the curves for the smaller sizes of wire, and Fig. 2 those for the larger. The curves in the first set show the relation between ampere turns and mean length per turn, and

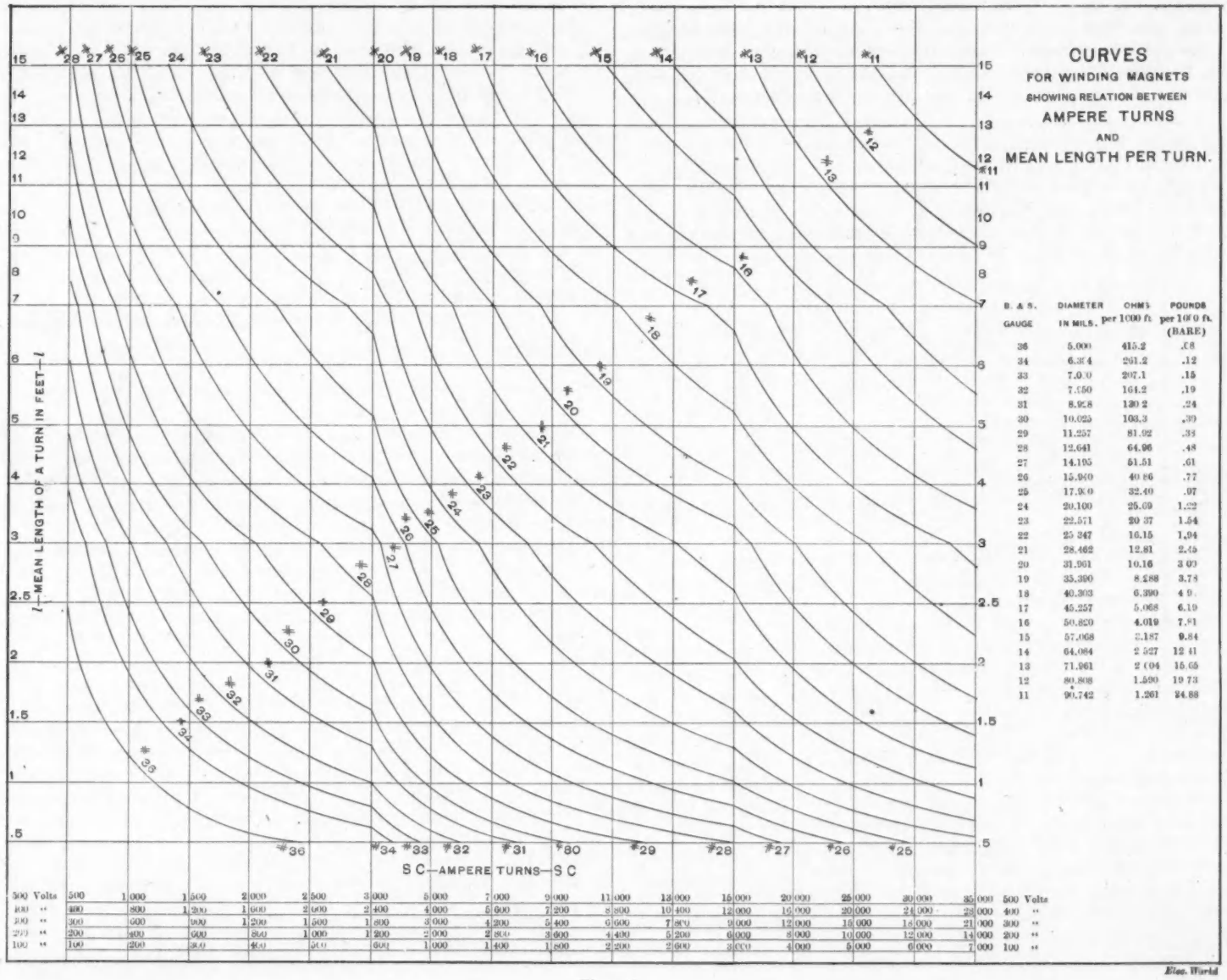


FIG. 1.

those in the second set the relation between current and total length of wire. It is a familiar fact that increasing or decreasing the total length of wire on a magnet will not alter the number of ampere turns, providing the mean length per turn is not changed. The only effect will be to decrease or increase the current density. Therefore, if a certain size of wire is found from set No. I. to give the desired number of ampere turns, any current density or length of wire can be chosen from the curve for that size of wire in set No. II., depending only on the independent limitations of space, heating effects, efficiency, weight, etc.

In using the curves for determining the shunt windings of dynamo machines care must be taken to use the actual electromotive force impressed at the terminals of the coil which is to produce the required ampere turns.

Construction of Curves in Set No. I.

L = total length of wire in feet.

l = mean length of a turn in feet.
S = total turns.
R = total resistance.
r = resistance per foot at 75° F.
E = impressed electromotive force.
C = current.

Multiplying the equation

$$C = \frac{E}{R}$$

by L, we have

$$L \times C = L \times \frac{E}{R}$$

But $L = S\,l$ and $R = L\,r$; hence

$$S\,C \times l = \frac{E}{r} \qquad (1)$$

r is constant for each size of wire. Therefore if E be taken constant at, say, 500 volts, the relation between $S\,C$ (ampere turns) and l (mean length per turn) will be represented by a rectangular hyperbola. This curve for each size of wire from No. 4 to No. 36 has been plotted for the value of $E = 500$, the abscissæ being values of $S\,C$ and the ordinates values of l.

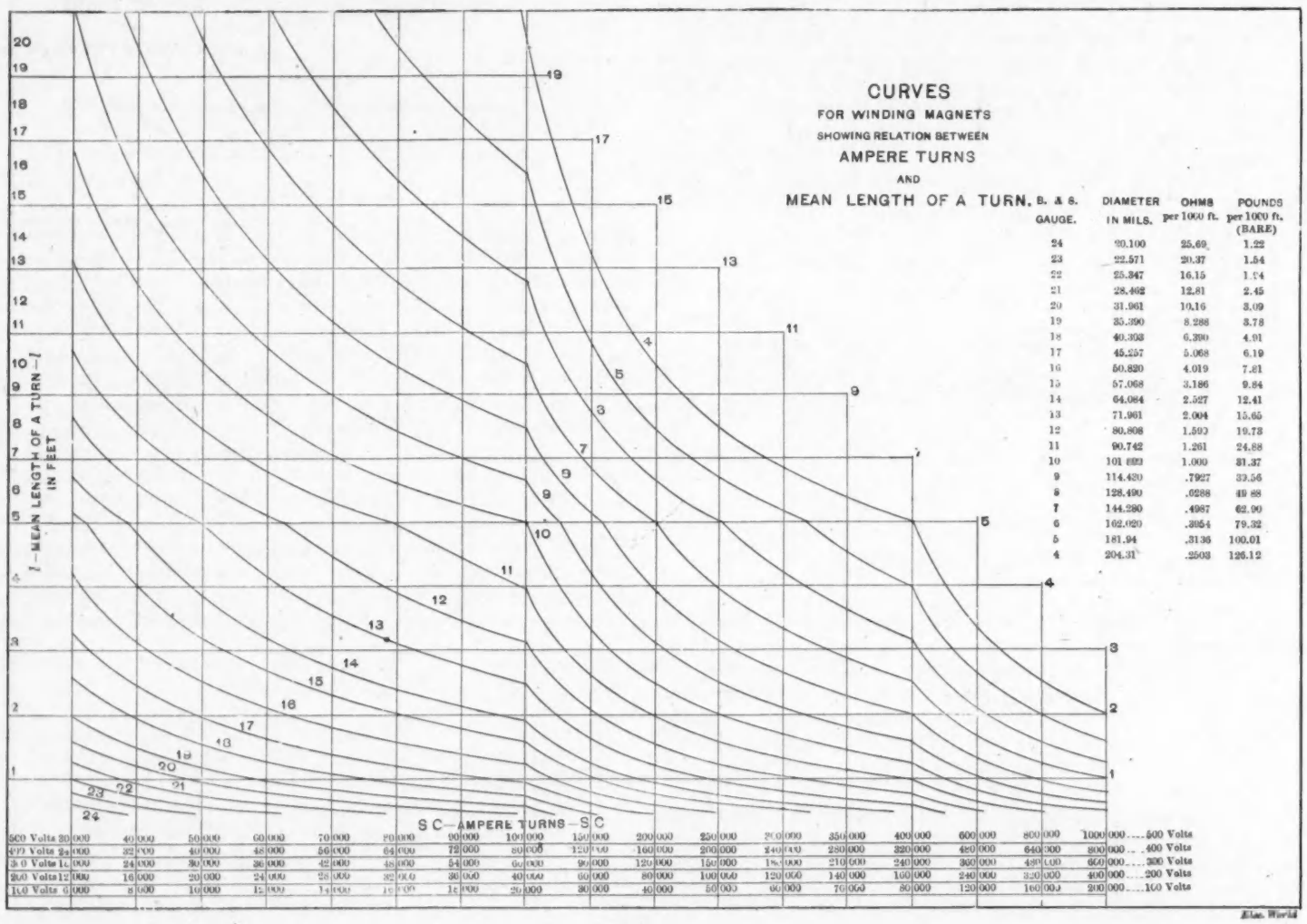
Since readings on a curve are most accurately determined when the inclination of the curve is most nearly 45 degrees, and since the intervals between the units on the two scales may be decreased as the number of units increases without increasing the percentage of error of the readings, the horizontal and vertical scales have been shortened at suitable points. The scale of abscissæ has been shortened in Fig. 1 at the values of $S\,C = 3{,}000$ and 15,000, and the scale of ordinates at $l = 3$ and 7; and on Fig. 2 at $S\,C = 100{,}000$ and 400,000, and at $l = 5$.

The curves can be used not only for an impressed electromotive force of 500 but for any value of E whatever. From equation (1) it is evident that if l and r remain constant $S\,C$ will be directly proportional to E. Hence, a scale for $S\,C$ may be plotted that will correspond to any desired value of E, and its readings for any point on any of the curves will be in the same ratio to the reading for 500 volts as the E. M. F. chosen is to 500 volts. Five scales have been placed on the sheets to correspond to E. M. Fs. 500, 400, 300, 200, 100; and readings for any other E. M. F. can be determined by simple arithmetical interpolation.

The limits of the curves have been chosen so as to include all values of $S\,C$ and l ordinarily met with in practice. The limits between which the values of l lie are ½ ft. and 18 ft., and those of $S\,C$ are 500 to 30,000 on sheet No. 1 and 30,000 to 1,000,000 on No. 2.

The value of r used in plotting the curves is for 75 degrees F. As field coils of a dynamo machine are almost always worked at a higher temperature than this, a temperature correction may have to be applied, and can be done as follows:

T = Temperature in degrees F. at which the coil will be worked.
r = resistance of wire per foot at T degrees F.
r_1 = resistance of wire per foot at 75 degrees F.
$S\,C$ = ampere turns at T degrees F.
$S\,C_1$ = the number to be looked for on the scale.



B. & S. GAUGE.	DIAMETER IN MILS.	OHMS per 1000 ft.	POUNDS per 1000 ft. (BARE)
24	20.100	25.69	1.22
23	22.571	20.37	1.54
22	25.347	16.15	1.94
21	28.462	12.81	2.45
20	31.961	10.16	3.09
19	35.890	8.288	3.78
18	40.303	6.390	4.91
17	45.257	5.068	6.19
16	50.820	4.019	7.81
15	57.068	3.186	9.84
14	64.084	2.527	12.41
13	71.961	2.004	15.65
12	80.808	1.593	19.73
11	90.742	1.261	24.88
10	101.893	1.000	31.37
9	114.430	.7927	39.56
8	128.490	.6288	49.88
7	144.280	.4987	62.90
6	162.020	.3954	79.32
5	181.94	.3136	100.01
4	204.31	.2503	126.12

FIG. 2.

Since the rise of resistance with temperature in copper wire is .21 per cent. per degree F. we have

$$r = r_1\left[1 + (T - 75) \times .0021\right]$$
$$= r_1\left[.0021\ T + .8425\right] \qquad (2)$$

From $$S\,C_1 \times l = \frac{E}{r_1} \text{ (at 75° F.)} \qquad (1)$$

and $$S\,C \times l = \frac{E}{r} \text{ (at } T\text{° F.)} \qquad (1)$$

we have $$\frac{S\,C_1}{S\,C} = \frac{r}{r_1}$$

and $$S\,C_1 = S\,C\,[.0021\ T + .8425] \qquad (3)$$

The value of $S\,C$ to be looked for on the scale can thus be found from the given value at T degrees F. by substituting the value of T in the above equation.

(To be continued.)

Electrodynamic Machinery.—XXXIII.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

186. An inspection of Figs. 148–150 will render it evident that the effect of superposition of the armature M. M. F. upon the M. M. F. of the field magnets, is to weaken the intensity of the field flux at the leading edges of the pole pieces, and to strengthen the intensity at the trailing edges of the pole pieces. At the same time, it is necessary to advance the brushes; *i. e.*, the diameter of commutation, so as to bring the commuted coils under the leading edges of the pole pieces, in order that they may receive a sufficiently powerful intensity of field flux to enable the armature current to be reversed in the coil under the brushes, and sparkless commutation thus to be effected. If, however, the number of ampere-turns on the armature; *i. e.*, its M. M. F. at a given load, be sufficiently great, the field flux at the leading edges of the poles will be so far weakened that the intensity left there will be insufficient to effect sparkless commutation, no matter how great the lead may be. In other words, the flux from the armature will overpower the field flux, in any position of the brushes. This will take place when the M. M. F. due to half the turns of active conductor on the armature, covered by the pole face, is equal to the drop of magnetic potential in the field flux through the entrefer.

187. The magnetic intensity under the edge of the leading pole piece will be zero, when the magnetic difference of potential between this polar edge and the armature core, immediately beneath, is zero. The magnetic difference of potential across the gap at this point due to the field flux alone, will be the magnetic drop in the entrefer, or $\mathfrak{B}d$, where $\mathfrak{B}$, is the field intensity in the gap with no current in the armature, and d, the length of the entrefer in cms. The total M. M. F. of the armature along the arc of one pole will be $\frac{4\pi}{10} w$, where w, is the number of turns covered by the pole, and this will be the total difference of potential in the magnetic circuit of the armature. Assuming that the armature is not operated near the intensity of magnetic saturation, almost the entire reluctance in the armature circuit will be in the entrefer. Fig. 152 represents diagrammatically the magnetic circuit of a Gramme-ring armature. The reluctance between *bc* and *cd*, in the field pole, also between *ef* and *fa*, in the armature, will be comparatively small, so that the total magnetic difference of potential developed by the armature will be expended in the two air gaps *ab* and *de*, half the M. M. F. of the turns beneath the pole face being expended in each air gap. Strictly speaking, the magnetic flux produced by the armature will not be confined to the paths indicated by the dotted arrows, but will pass across the air gap at all points not situated on the neutral line *cf*. The above principles may be relied upon, however, to a first approximation.

188. In order, therefore, that a smooth-core armature should be capable of sparkless commutation, the M. M. F. of the turns on its surface, covered by each pole, should be somewhat less than the drop of magnetic potential in each air gap. For example, if each air gap or entrefer has a length of 2 cms, and the intensity in the air is 3,000 gausses, the drop of potential in the air will be 6,000 gilberts. If the Gramme-ring armature turns, covered by one pole-piece, are 200, then a current of 80 amperes from the armature will represent 40 amperes on each side, and the M. M. F., produced by this current, will be $\frac{4}{10} \times 40 \times 200 = 10{,}056$ gilberts, and half of this amount, or 5,028, being less than the drop of field flux in the gap, should leave a margin for sparkless commutation.

189. Although the preceding rule enables the limit of current for sparkless commutation, on a smooth-core armature, to be predicted under the conditions described, yet it by no means follows that sparkless commutation must necessarily be obtained if the M. M. F. of the armature lies within this limit. If, for example, the number of commutator segments is very small, the inductance of each segment may be very considerable, and a powerful flux intensity may be required to reverse the current under the brush in the presence of such inductance. No exact rules have yet been formulated for the determination of the inductance in a coil with which a given current strength, speed of rotation, and field intensity, shall render sparkless commutation possible.

190. The methods in general use for the suppression of sparking may be classified as follows.

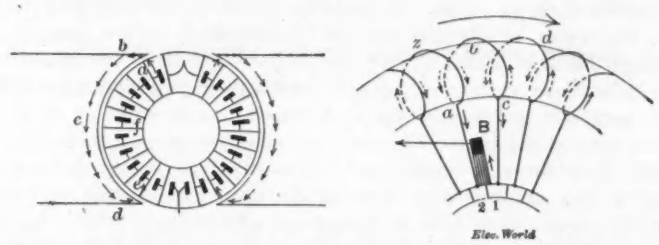
(1). Those which aim at the reduction of inductance in the commuted coils.

(2). Those which aim at the reduction of the current strength passing through the coil during its short circuit by the brush, and, therefore, at the reduction of the current strength which must be reversed before the short circuit is over.

(3). Those which aim at the reduction of the armature reaction, or its influence in weakening the field intensity in which the coil is commuted.

191. There are two methods for reducing the inductance of the armature coils. The first is to employ a great number of commutator segments, thus decreasing the number of turns in each coil under commutation. It is evident that an indefinitely great number of commutator segments would absolutely prevent sparking. A great number of commutator segments is, however, both troublesome and expensive, so that in practice a reasonable maximum cannot be exceeded. The second method for lessening the inductance of the armature coils differs from the preceding only in the method of connection. It consists in providing two separate windings or sets of coils, or, as it is sometimes called, in double-winding the armature. The two separate windings are insulated from each other, but are connected to the commutator at alternate segments, so that the brush rests coincidently upon segments that are connected with each winding. Each winding, therefore, furnishes half the current strength and the effect of the inductance in each coil is reduced.

192. When the brushes are not so shifted as to bring the diameter of commutation into coincidence, or even in advance of the neutral point, the coil under commutation will be situated in a magnetic flux in the wrong direction; *i. e.*, a magnetic flux which tends to increase and not to reverse the current strength in the coil, so that when the coil is short circuited by the brush, the current strength



FIGS. 152 AND 153.—CURRENT FLOW IN ARMATURE WINDING.

becomes increased in the wrong direction. When, for any reason, it is impossible to alter the lead of the brushes during variations of load, as, for example, when the generator has to run without attendance, the sparking, which may be produced at the brushes owing to the resultant flux in which the commuted coils lie, may be greater than that due to the mere reversal of armature current in the coil under the influence of its inductance. In such cases, considerable improvement is effected by the insertion of a resistance between the coils and the commutator segments with which they are connected. Thus in Fig. 153, the connecting wires *a*2 and *c*1, are sometimes made of German silver. It is evident that under these circumstances, the coil undergoing commutation will not only have the resistance of the coil, but also the resistance of the German silver wires in its local circuit through the brush, and the current, which can be set up in this circuit by the E. M. F. induced in the coil, owing to its motion through the distorted field, is prevented from assuming considerable strength. The value of the German silver resistances, although great by comparison with the resistance of a single coil, is small when compared with the resistance of the entire armature, and, consequently, does not greatly add to the armature's effective resistance. It is clear that this method does not obviate the sparking due to the inductance of the armature coils, but tends rather to obviate that due to the establishment of unduly powerful currents in the short circuited coil in the wrong direction, and which current has suddenly to be reversed when the short circuit is broken. The method is, therefore, generally employed with armatures for which the brushes cannot be shifted.

193. The most generally adopted plan for reducing sparking is to employ a comparatively high resistance in the brush itself. An examination of Fig. 153, will show that if the resistance in the tip of the brush B, can be made sufficiently great, the current which enters the commutator from the wires will be so far reduced, before contact with the brush tip ceases, that when the rupture does take place, practically all the current from the armature will be passing through the coil in the right direction; *i. e.*, in the same direction as that it will have when the brush has passed to the next coil, and,

consequently, the current strength which has suddenly to be reversed when the brush leaves the bar is very small.

194. Thus in Fig. 153, suppose the armature is rotating in the direction of the large curved arrow, the commutator segment 1 is about to move from beneath the brush *B*. The coil 2 *a b c* 1, is about to change position, from the left hand to the right hand side of the armature, and the current in the coil is about to change in direction, as indicated by the small curved arrows, from the direction *a b c*, to

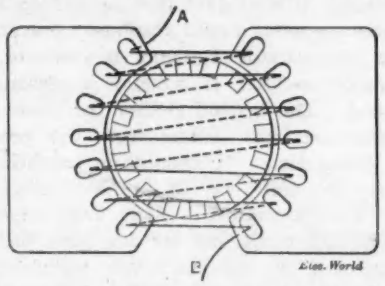


FIG. 154.—DEVICE FOR PREVENTING ARMATURE REACTION.

the direction *c b a*. The current leaving the armature having recently been flowing to the brush *B*, from section 1, and the wire *c* 1, is now flowing from sections 2 and 1, and from wires *a* 2 and *c* 1. If the resistance in the tip of the brush is considerable relatively to that in the whole breadth of the brush, the current through *c* 1 *B*, will be relatively reduced, and that through *a* 2 *B*, relatively increased. This will require, however, that the current from the right hand side of the armature shall be forced through the coil *b*, in the direction *c b a*, and the more nearly this can be accomplished before contact is broken between 1 and *B*, the less opportunity there is offered for the inductance of the coil *a b c*, to produce a spark at rupture. With this purpose in view, brushes are made up of strips of German silver interleaved with copper or of woven gauze; or they may be made of carbon with a specially high resistivity. This plan tends to reverse the current in the armature, during the period of short circuiting, and also aids in checking any undue current in the wrong direction, caused by distortion of the field flux, owing to armature reaction.

195. Referring now to the third method, a variety of plans have been attempted at different times for bringing about a reversal of the current in a commuted coil, during the period of short circuiting, by the action of a specially directed magnetic flux upon this coil, as, for example, by winding a special magnet placed with its pole immediately over the short circuited coil, in such a manner that

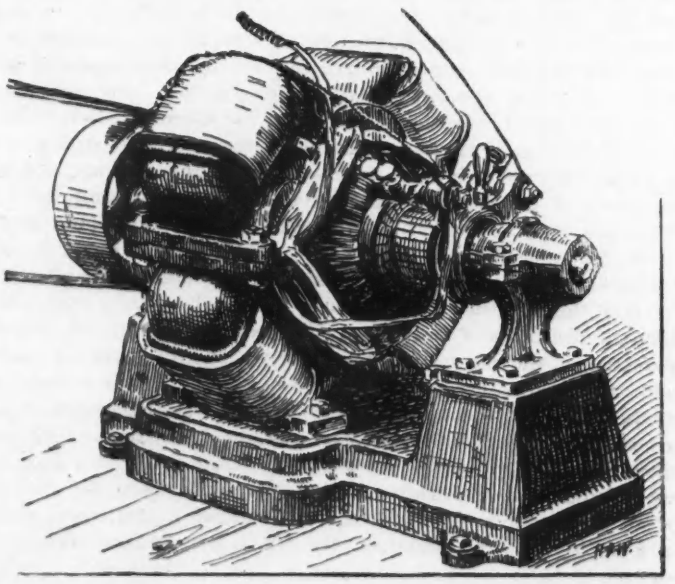
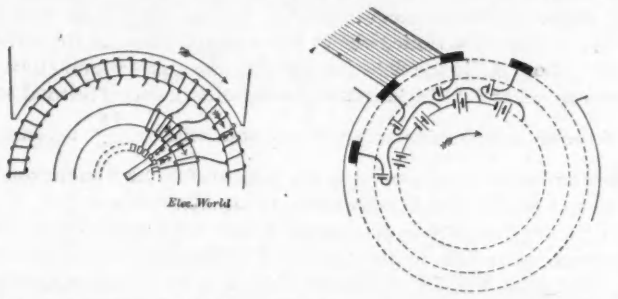


FIG. 155.—QUADRIPOLAR GENERATOR WITH BALANCING COILS.

the flux from this magnet, penetrating the commuted, revolving coil may induce in it an E. M. F. sufficiently powerful to set up, in the short circuit, a current strength equal to that which the coil must sustain after commutation is over. In other words, to produce automatically that which the lead of the brushes would be capable of effecting under the most favorable conditions. When, however, the current through the armature and its M. M. F. are powerful, the M. M. F. needed on such controlling magnets may require to be very considerable, and, for this reason, the plan in this form has never come into general use.

196. In this direction a method has recently been proposed for obtaining sparkless commutation by introducing into the magnetic circuit of the machine, a M. M. F. equal in amount, but opposite in direction, to that of the armature. This has the effect of practically preventing all armature reaction and distortion of the field flux. It is carried out by winding around the armature and through the field poles, as shown in Fig. 154, a number of turns, between *A* and *B*, equal to that of the armature winding, and in series with the armature, so that the ampere turns in the balancing coil *A B*, are equal and opposed to the ampere turns on the armature. The two M. M. Fs. thus counterbalance and neutralize each other, leaving the field flux practically unchanged at all loads of the machine. By this means all sparking due to distortion of the field is prevented, and only the sparking due to the inductance of the commuted coil and the current reversal in the same is left. In order to check this, an additional winding or magnet over the commuted coil is introduced for the purpose of reversing the E. M. F. in this coil as above described, a process which is more usual of application when no armature reaction exists than when armature reaction is unchecked. A quadripolar machine wound in this manner with a quadruple set of balancing coils is shown in Fig. 155.

197. While it is claimed for this method that it entirely overcomes armature reaction, yet it possesses the disadvantage that it



FIGS. 156 AND 157.—DEVICE FOR PREVENTING SPARKING.

requires the use of what is practically an extra armature winding upon a part of the machine which does not revolve, thus introducing an additional cost and complexity. It, therefore, remains to be determined how far the advantage of sparkless operation is offset by extra resistance, weight, material, and cost.

Another method which has been tried in England for the purpose of suppressing sparking, adds extra coils on the armature, one between each commutator segment and the armature connection. These coils are arranged in such a manner that the E. M. F. induced in them by their revolution through the field shall reverse the direction of the current in the coil under commutation. Fig. 156 represents the method of winding, and Fig. 157 the action of the various E. M. Fs. In Fig. 156 the inner ring with the additional coils actually forms part of the armature core and receives the flux from the field. Fig. 157 shows the coil *x*, being short circuited by the brush, and the direction of the current in this coil is being reversed by the action of the auxiliary coil *c*, which is still under the trailing pole edge, so that when the bar *B*, leaves the brush no serious spark shall follow.

198. In one dynamo-electric machine having but three commutator segments, the spark is prevented from forming by an air blast directed against the commutator in such a manner as to extinguish the incipient spark at the breaking of the short circuit. This air blast is supplied by a small centrifugal pump rotating with the armature.

199. Thus far we have mainly considered smooth-cored armatures. The great majority of dynamos, in construction at the present time are, however, toothed-cored armatures. In the first production of these machines, the sparking which they exhibited was more troublesome and violent than in smooth-cored armatures of equal size, and apparently for the reason that the inductance of each armature coil was increased, owing to its being surrounded, or nearly surrounded, by iron, instead of having an iron base only, as in the smooth cored type. This difficulty has since been overcome by careful designing, and toothed-cored armatures are now constructed which give less trouble from sparking than smooth-cored armatures of equal size and output. This is accomplished by giving such a cross section to the teeth in the armature that, at no load, the iron in the teeth is

nearly saturated, and has, therefore, a high reluctivity. The presence of armature reaction tends to increase the intensity in the teeth beneath the trailing pole edges, and to diminish it in the teeth beneath the leading pole edges, as already observed. This tendency is opposed by the increasing reluctivity of the saturated teeth at the trailing pole edges, and, consequently, the teeth tend to restore an equal distribution of magnetic flux over the surface of the armature; or, in other words, tend to check the effect of armature reaction. At the same time, the high reluctivity of the teeth tends to diminish the inductance of each coil undergoing commutation, so that, by careful adjustment, the existence of the teeth is not merely a mechanical but also a considerable electrical advantage.

In practice, the output of a generator is not really limited by excessive sparking. As usually designed, the temperature elevation of the armature, even when thoroughly ventilated, fixes the limit to the output before the sparking becomes troublesome. And, in fact, many generators are to-day in use which never require to have any lead given to their brushes and need only occasional attention to their commutators.

200. In the preceding discussion, we have considered armature reaction from the standpoint of the Gramme-ring armature only, but the same principles are equally applicable to disc or drum armatures.

Laboratory of Houston and Kennelly, Philadelphia.

(To be continued.)

Self Inductances.

MM. Roosen, Colard and Close in the current number of the *Bulletin* de la Socéité Belge d'Electriciens give the result of some measurements of self-inductances, from which the following table has been compiled:

	Resistance ohms.	Current milliamperes.	Self-Inductance.	
			Armature up.	Armature down.
Magnets of Morse apparatus—				
One coil	890	10	15	18 6
Two coils in series	——	10	47.3	54 5
Two coils in parallel	——	10	11	14.2
Vibrating bell	776	10	18.6	45 5

The writers ascribe the difference in the value of the self-inductance of the Morse magnet with the armature up and the armature down to a difference in saturation. While the value of a self inductance depends upon the leakage and saturation, it also depends upon a varying reluctance, which in the present case is the principal factor.

The Edinburgh, Scotland, Municipal Station.

The Edinburgh municipal electric suply station, which has been recently opened, is desiged for both continuous and alternating current supply; the former working on the three-wire system for the nearer districts, and the latter working at high pressure with transformers, for the districts which are more remote. The plant capacity of the station is 40,000 glow lamps and 175 street arc lamps. A battery ot the newest type of Crompon-Howell storage cells has been erected. The alternating current is supplied at a frequency of 60 periods, from two Ferranti alternators direct coupled to Willans engines. Besides supplying the outlying districts, these alternators also drive the street arc lamps through Ferranti rectifiers. The feeders consist of armored cables for the alternating currents, and bare copper in conduits for the continuous currents. The distributors consist of covered cables in earthenware conduits. The charge for supply will be 12 cents per kw in the night, and seven cents during the daytime; and a system of discounts will be adopted.

Perhaps the Truth, But—

In its reports of the meetings of the English Institution of Electrical Engineers, one of our English contemporaries indulges in rather pointed personal criticism, of which the following is an example: "After Mr. —— arose the irrepressible Dr. ——, whose penetrating voice and exasperating drawl the long-suffering audience endured until his allusion to some experiments on mice, guinea pigs, etc., gave Mr. Preece a chance for a joke to the effect that the guinea pigs were, perhaps, directors. The pent-up feelings of the members were relieved by a burst of laughter, and the learned doctor subsided, wondering what they could find to laugh at."

Electrical Terminology.

To the Editor of The Electrical World:

SIR: In the London *Electrician* of about a month ago, a letter of mine was published, in which it was urged that as "kation" was the name originally given to the ion separating at the kathode, and as it is undoubtedly a word etymologically correct, whereas "kathion" is incorrect, a return should be made to the older terminology. Unfortunately the aspirated form of the word has crept into some modern books, and into many articles in electrical journals, but I think it is a pity for the error to be perpetuated.

From one point of view, it is a small matter, but if we are to use words derived from the Greek at all there is no reason why they should not be derived properly, and really show their origin. The word "ion" is the neuter participle of the verb *εἶμι* and means *the thing going*. The compound *κάτειμι* gives the participle *κάτιων the thing going down* (with the current). There is no participle *κάθιων* and therefore no ground for introducing the aspirate into English. A correspondent to the *Electrician* criticising my letter suggested *καθίημι, to send down*, as the origin of "kathion," but there is not much difficulty in showing the incorrectness of this view and that his argument is untenable.

As THE ELECTRICAL WORLD is so widely circulated, I think that if you were to insist that all articles published in your paper should adopt the correct spelling, your readers who may not have considered the question of origin and may have become accustomed to "kathion" would soon quite naturally use "kation," and thus one etymological barbarism would be removed from electrical literature.

Royal Military College of Canada. JOHN WADDELL.

Electrical Power Transmission at High Voltages.

To the Editor of The Electrical World:

SIR: In your issue of March 16, Dr. Louis Bell states that there is at present no plant operated at more than 10,000 volts. I wish, however, to inform your readers that the power plant of the Oerlikon Works, which has been in steady and successful operation for nearly three years, works actually at an effective pressure of 13,000 volts. No serious trouble has been experienced with the insulation of the line, which is of bare copper supported on large porcelain insulators of a special type. EMIL KOLBEN.

OERLIKON, Switzerland.

To the Editor of The Electrical World:

SIR: I am pleased to be corrected by Mr. Kolben regarding the voltage of the three-phase power transmission plant at the Oerlekon Works. My information was derived from publications in the technical papers shortly after the plant was installed, and the voltage was given at about half that mentioned by Mr. Kolben. It is not unlikely, as in the case of the San Antonio transmission plant in California, that the voltage originally tried was half the final voltage. At all events, the present conditions of operation bear out in a very gratifying manner the statements in my article concerning the feasibility of operating transmission lines at and above 10,000 volts without extraordinary precautions for insulation. I am much obliged to Mr. Kolben for the information and correction.

Chicago, Ill. LOUIS BELL.

The Bonta Telephone Patents.

To the Editor of The Electrical World:

SIR: In your issue of April 13th, in connection with your article on the Standard Telephone Company of New York, in closing you state that you have learned that, amongst other patents, the Standard Telephone Company control the Bonta patents. We will consider it a favor if you will correct this error in your next issue, as all of the Bonta patents are owned absolutely by us.

M. & B. TELEPHONE CO.

PHILADELPHIA, PA.

[The officers of the Standard Telephone Company state that they do not control the Bonta patents, and never asserted that they did so. Our information was obtained from the presumably official public statement announcing the formation and plans of the Standard Telephone Company.—ED.]

Electric Traction in Oporto.

A contract has recently been secured, in competition with several German firms, by the French Thomson-Houston Company for the construction of an electric tramway, about two miles long, on the overhead-conductor system in the city of Oporto.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 927 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French, or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Induction Motor.—In a short article by Mr. Kennedy in the Lond. "Elec. Rev.," April 5, on "The Early History of the Polyphase Motor" he expresses his belief that the Bailey motor was the first true polyphase induction motor yet discovered. He criticises very unfavorably the recent American Institute paper of Lieut. Reber, the results of whose "bewildering mathematical formula" he claims are useless to an engineer; he reprints Mr. Steinmetz's simple theory of the induction motor. (See also THE ELECTRICAL WORLD, April 20, p. 474.)

Alternating Current Motors.—The Lond. "Elec. Rev.," March 29, begins an article by Mr. Rhodes of a general nature; in the present portion he discusses synchronous motors and their theory.

Dynamo with Single Bearing.—A translation in abstract from the French, of the dynamo mentioned in the Digest, March 9, designed by Mr. Helmer of the Cail Company is given with illustrations in the Lond. "Elec. Eng.," April 5.

Motor Alternator—The "West. Elec.," April 13, reprints the description with the illustration of the laboratory machine mentioned in the Digest, March 23.

LIGHTS AND LIGHTING.

Comparative Measurements of Different Incandescent Gas Lights.—An article by Dr. Wedding is reprinted in the "Elek. Zeit.," April 4; it contains the results of measurements in the form of tables and curves.

Effective Electric Lighting.—Mr. Maycock in Lond. "Elec. Eng.," April 5, describes and illustrates some incandescent lamp shades, an inverted arc lamp, and a horizontal one.

Specifications for Street Lighting by Arc Lamps.—The "Eng. News," April 11, reprints the specifications prepared by Mr. Judson for the street lights now furnished to the city of Oswego.

POWER AND HEAT.

Electricity in Factories and Workshops.—The Lond. "Elec. Rev.," April 5, abstracts from "L'Elec.," the recent descriptive article on the plant at a ribbon and silk manufactory in St. Etienne.

Distribution of Power from Niagara.—An illustrated descriptive article by Mr. Perkins is published in the "West. Elec.," April 20; it concludes a good illustration of the transformer room showing the rotary and the stationary transformers.

TRACTION.

Electrolysis of Pipes.—The "Elek. Zeit.," April 4, contains an article by Dr. Rasch in which he discusses a number of points involved in the return circuit for electric railways, in order to prevent electrolysis of underground pipes. Regarding the use of earth plates he states that in endeavoring to reduce the voltage one should be careful that in doing so the resistance of the earth circuit is not reduced to a greater extent than the voltage or else the results will be worse than before; if the resistance between the conductors and the earth is relatively small, then the effect of earth plates on the total resistance of the earth circuit will be very small and the loss of voltage, as also the current strength, will be affected only slightly but in the same direction as in the first case; the earth plates will in this case at least be of no advantage; in both cases the earth plates will tend to distribute the current in the neighborhood of the central station and thereby will diminish the current density, but he argues that if it is not possible to avoid the damage which the current does, it is certainly preferable to localize it on a few pipes even if these must be changed more frequently. He discusses mathematically the question of a return copper circuit parallel with the rails, and finds that to reduce the current flowing through the earth from 6 to 5 per cent. of the total current, it will be necessary to have a copper return circuit containing 3.5 times as much copper as the feeders; this is based on very effective bonding but if this does not exist the return circuit would have to be still larger; he concludes that good bonding is much better than an extra return circuit.

Breakdown Tests with Railway Line Material.—In "Elec. Power" for April, Mr. Sever publishes the tabulated results of breakdown tests on various kinds of insulators and fixtures for railway lines. The tests seem to indicate that with 1,200 volts there is very little danger from breakdowns, the leakage over wet surfaces being much more serious; there appears to be no necessity for improving the quality of the insulating materials to guard against higher potentials, but some change seems necessary to protect the system from a considerable loss through leakage. The apparatus used for testing is briefly described; it consists of a separately excited alternator and step-down transformer with a ratio of 10 to 1, and a step-up transformer with a ratio of 1 to 500, the voltage in the latter circuit, which may be raised to 50,000, being that which is used.

The Electric Railway for Interurban Traffic.—In a short article by Mr. Pope in "Elec. Power" for April, he compares the relative merits of electric and steam roads for interurban traffic.

Lenox Avenue Conduit System.——A well illustrated description is published in "St. Ry. Gaz.," April 13; the "Elec. Rev.," April 17, also contains a description with some of the illustrations.

Fenders.—The "St. Ry. Gaz.," April 13, abstracts the portion of the Massachusetts Street Railway Statistics on the requisites of an efficient fender.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

The Varying Cost of Electricity Supply.—In an article under this heading by Mr. Wright in the Lond. "Elec.," April 5, he discusses the cost of supplying electricity showing how it varies in practice according to the number of hours per day during which the consumers use the current; he refers more particularly to the experiences at Brighton where his system of charging has been in use for two years. He shows by means of two curves the improvement in the load factor due to the adoption of his system. The annual sale of electricity per maximum kw taken from the mains, has increased nearly 25 per cent., the figures being arrived at by dividing the kw hours sold, by the greatest demand in kw experienced at any moment; they show that the average demand and the maximum demand have been brought more nearly to coincidence; the revenue derived from the maximum kw has increased about 10 per cent. although the average price obtained fell more than 12 per cent.; the sale of current has nearly quadrupled since the adoption of the system while the maximum load at the generating station increased only three-fold; another advantage obtained is in the introduction of the light into basements, kitchens and other places where it would not be introduced so readily under the uniform system; the average number of kw hours consumed per lamp installed has increased 15 per cent., while generally the reverse is the case. He compares the table of figures in Mr. Leonard's recent American Institute paper, for the estimated power charges on a sliding scale, with one prepared by himself, applied to the Brighton station; the latter figures average less than half and do not vary nearly as much. He discusses the subject of standing charges and the running cost per unit; for the Brighton station for this year they work at 12 cents per day per kw demanded for the former and two cents for running costs. The costs in the Brighton station will be about met if the consumers use their demand on the average one hour per day and paying during the first hour 14 cents per kw hour, after this it may be assumed that the cost of supplying each kw hour will not exceed two cents. As there are really only two divisions in the items constituting the cost of supply, namely, standing and running cost, it is therefore only necessary to have two rates of charges in order to obtain a perfectly equitable sliding scale and this without involving hardly any more clerical work than a uniform price system. That station he believes holds the record for the lowest cost of production and the greatest sale per inhabitant, which he believes is attributable largely to the sliding scale used. He attaches importance to the superiority of a system giving rebates based on a consumer's actual use of the generating plant and mains, over one based on the more or less prolonged use of the lamps installed; the former encourages the general use of the light in a house while the latter has the reverse effect. In a table he gives the following figures showing the percentage of consumers who use their demand on the average as follows: less than one hour per day 13.6 per cent., more than one and less than two hours 38.6 per cent., more than two and less than three hours 32.1 per cent., more than three hours 15.8 per cent.

Best Combination for Electric Light Undertaking.—A long paper by Mr. Dawbarn is reprinted in the Lond. "Elec. Rev.," March 29, and

April 5, and is to be continued. He discusses the best mechanical and electrical equipment for an electric light station under the normal conditions of an English provincial town. Regarding the system, he states that the great duel between alternating and direct currents has been "fought to the bitter end and one of them is dead" (referring apparently to the continuous current system); he gives two comparative maintenance estimates for a town of about 55,000 inhabitants to provide service during the whole day; these are given in detail and show that the cost per kw hour for the continuous current system with accumulators is about 1 per cent. higher than that for the high tension alternating current system; in making future extensions by putting down feeders double the length of those serving the first area, it can be done for double the cost of the first feeders for the alternating current system, while for the direct current system it would involve four times the cost of its first feeders; as the area of supply grows the difference between the annual cost in the two systems will therefore become more and more marked, increasing in favor of the alternating current system. Regarding the load diagrams he gives the following data: the average load factor is 10 per cent.; given the energy sold in December, that sold per year will amount to about 60 per cent. of this multiplied by 12; that sold on the lightest summer day represents only about $\frac{1}{6}$ of that sold on the average December day; the maximum current in June or July is between ¼ and $\frac{1}{5}$ of that in December; the minimum current in direct current stations may be only $\frac{1}{50}$ of the maximum winter load and with alternate current stations about $\frac{1}{25}$ or with separate house transformers 6 to 7 per cent.; the midday current on a fine winter day is less than $\frac{1}{7}$ of the maximum evening current. Regarding generating units he states that the day load unit should have a capacity not less than 14 per cent. of the total plant capacity, and to allow for extensions say 20 to 25 per cent.; he does not believe in starting with too many units notwithstanding that for the time being the fuel consumption may suffer; the cost of fuel is much less important than that of labor; the capital outlay is also greatly reduced by adopting the larger units; he suggests having the units not all of one size. The subject of boilers is briefly discussed. Regarding direct coupling he states that although more expensive, the difference is much more than covered by the saving in floor space, buildings, rope renewals and fuel consumption; the loss due to rope driving he gives as 6 per cent. on full load or 10 per cent. on the average load. Regarding engines he considers the vertical marine type the best with sufficiently high speed to make the extra cost of the direct coupled combination negligibly small. In discussing high vs. low speeds he admits that slow speed engines save fuel but shows that it would have to save 70 per cent. of the fuel to justify its adoption, considering the capital outlay only. Regarding the day load unit he advises adopting a slow running day load set in order to reduce the amount of attendance. Concerning condensing he states that one should go considerable distance for water rather than sacrifice condensing; where condensing water is not attainable an evaporator condenser should be used which requires even less water than would be used for boiler feeding; where there is plenty of condensing water there is room for debate as to the best way of using it. He recommends avoiding the use of donkey engines; electric motors may be used for the automatic stokers but he objects to electric boiler feed pumps. He claims that each alternator should have its own direct coupled exciter.

Load Factors.—See abstract above.

Central Station Statistics for Germany.—The "Elek. Zeit.," April 4, publishes a large table containing a list of all the central stations in Germany with some brief tabular data concerning each one; it is doubtless the most complete table of its kind published for that country. Eighty-one per cent. of the number of stations use the continuous current and represent 78 per cent. of the total power; 54 per cent. of the stations use steam power, representing 81 per cent. of the total power; only a few use water power exclusively, and still less use gas; over one half of them have a capacity of less than 100 kw; there are 43 medium large stations and 20 very large ones; only 15 per cent. of the energy is used for motors. There are altogether 148 stations representing 33,896 hp of machinery besides 4,589 hp in accumulators; of the 148 stations 80 use the continuous current with accumulators, 40 the same without accumulators, 15 use alternating currents and the other five, mixed systems; the number of 50-watt incandescent lamps connected is 493,081, the number of 10-ampere arc lamps is 12,357, the horse power of motors connected is 5,635. It seems that these statistics are for the present date, April, 1895.

Electric Lights for Railway Purposes.—Mr. Langdon's paper is reprinted in full with illustrations in the Lond. "Elec.," April 5. A reprint is begun in the Lond. "Elec. Rev.," April 5, and the discussion, which contains nothing of particular interest, is given briefly in the Lond. "Elec. Eng.," April 5; the paper was abstracted in the Digest last week; it contains nothing regarding the lighting of trains.

Coupling Dynamos for Arc Lighting.—In a short article by Mr. Lea in the Lond. "Elec., Eng.," April 5, he suggests a method by which arc lighting dynamos for series lighting can be connected in series on the same circuit in order to supply increasing amounts of energy as lights are put in circuit. It consists essentially of properly designed switches for putting additional machines in and out of circuit; it appears that the armature of an additional machine is first switched into circuit, which may be done whether the machine is running or not; the field is short-circuited and has a resistance across its terminals, which resistance may be adjusted and acts as the usual shunt for such series machines; the shunt is first short-circuited and is then gradually increased until the machine supplies the proper voltage. With ordinary switches it would be possible to short-circuit a working machine, and to prevent this his switch cuts out the field coils first before the armature is short-circuited; the switch is illustrated.

Electric Circuits in Streets.—The "Elek. Zeit.," April 4, reprints a long paper by Dr. Kallmann, chiefly of local interest, on the rules and regulations for electric circuits in the streets of Berlin; a diagram is given showing the location of all the underground wires and pipes in a cross section of a street; he discusses the effects of different circuits on each other, their protection, explosion in conduits, etc.

Municipalization of the Berlin Stations.—A long report forming part of the argument concerning this proposed change, is reprinted in full in the "Elek. Zeit.," April 4.

Salzungen.—An illustrated description of the installation in this town, in which accumulators are used, is given in the "Elek. Zeit," April 4; the accumulators are placed at substations.

Day Load for Central Stations.—"Elec. Power" for April contains an article by Mr. Perry entitled "Working out its Own Salvation" in which he calls attention to the great disadvantages in not having a constant load and suggests two remedies, one consisting in equalizing the load by storage and the other in supplying a productive load to which the machinery may be shifted when not fully occupied for the purpose for which it was installed; the latter method he considers far preferable, as it increases the gross income 2½ times and the net income probably still more; he suggests a number of methods by which this may be accomplished; what is required is some load which may be entirely under the control of the central station. Among the industries already well established in which electricity has supplanted other methods he mentions the following, discussing each in detail: the bleaching of textile fabrics, the electrical refining of metals and the products of the electric furnace. The article is to be continued.

Classification and Selection of Lighting System.—Prof. Crocker's article is concluded in the "Elec. Eng.," April 17. He discusses briefly the selection of a system, the size of plant, and alternating vs. direct currents.

Electrical Distribution in Office Buildings.—A brief abstract of an address by Mr. Pierce, giving a few general hints on the selection of machinery, is published in "Elec. Eng'ing" for April.

Brooklyn.—The new station of The Citizens' Electric Illuminating Company is described and illustrated in the "Elec. Eng.," and "Elec. Rev.," April 17.

Los Angeles.——An illustrated description of the electric light station in this city, by Mr. Guy, is contained in the "Elec. Eng.," April 17.

WIRES, WIRING AND CONDUITS.

Explosions.—The "Lond. Elec. Rev," March 29, discusseseditorially the St. Pancras and the Southwark bridge explosions; according to the report of Major Cardew regarding the latter, the cause was not due to electricity, but it was due to the electric conduits that the explosion was allowed to travel along them; as it may not be possible to prevent leaks from gas pipes, it suggests that conduits may have to be abandoned and the mains imbedded in such a way that there shall be no space surrounding them for the accumulation of explosive mixtures.

Electric Mains in Paris.—The Lond. "Elec. Eng.," April 5, publishes a translation with illustrations of the recent article by Mr. Monmerque mentioned in the Digest Jan. 26, Feb. 23, March 23.

Paper as an Insulator for Electrical Conductors.—The third and last article by Mr. Bishop on this subject is contained in "Elec. Power" for April. He states that like everything else paper has its place and limits; for underground work or even for overhead work it is superior to anything else known as long as the integrity of the lead sheating remains; but for submarine or exposed overhead work, for leading-in wires and other similar work subject to exposure to damp and atmospheric changes, it is practically useless. He shows that the discovery of paper as an insulator for a conducting wire is old, but its application for producing a low capacity is comparatively recent. He refers to the gradually increasing size or sectional area of conductors used for light and power purposes and shows that in this the employment of rubber or any of the asphalted compounds is very unadvisable while the use of the so-called fibre compound, is impossible; a very wide margin must also be allowed for the mechanical strains which the insulation must bear; for these large conductors paper seems not only to be the best possible insulator, but the only one available.

Underground Conduits and Cables.—An article on this subject is begun by Mr. Maver in "Elec. Power" for April. He calls attention to the rapid increase in amount of underground conduits and cables, stating that in 1882 there were perhaps not more than 10 miles of underground conduits in the United States, while now the aggregate length of underground conductors in this country alone may be placed at 175,000 to 200,000 miles, of which perhaps 2,500 to 3,000 miles are used for electric light and power service exclusive of railway feeders, and the remainder for telegraph, telephone, and like purposes; he quotes a few extracts from the opinions of scientific authorities, superintendents and others who expressed adverse views in 1888. In the present article he intends to give a description of a number of electrical subways in operation in this country and Europe, and of the conductors and cables which they contain, with comments concerning the advantages and disadvantages of existing systems. He discusses the nomenclature and begins the illustrated description of some subways and tunnels.

Wire Joints.—In a short article on "How to Join Wires" in the "Teleg. Age," April 16, a table is given containing the results of tests of the breaking strain of a number of different joints, the tests having been made by Mr. Davis, of the Postal Telegraph Company. Most of them are the mean results of about 10 samples and all were made with No. 10 B. & S. copper wire. For the ordinary twist joint, with solder poured over the joint and wire, the average breaking strain of the joint, in per cent. of strength of the wire, was 83, the joint having 7 turns on each side of the centre; when the solder was poured on the thick part of the joint only, and not allowed to touch the wire elsewhere, the per cent. of breaking strain was 100, the joint having 5 twists on each side; the three-wire or Western joint with 7 turns, soldered in the same way, gave the same results; without solder the ordinary twist joint with 7 turns fell to 53 per cent.; for the McIntire joint with a 5-inch stem and no solder the value was 93 per cent. and 82 per cent. for 4 and 3 twists respectively.

Kelvin's Law of Economy in Conductors.—Mr. Perrine's article is continued in "Elec. Eng'ing" for April; it does not admit of being abstracted. From one of his equations he draws the following conclusions: "The maximum value of the net income in any transmission when the values of the resistance of the line and the electromotive force delivered are fixed, is at such a value of the current that the gross income, less the cost of the energy generated and delivered, equals twice the value of the energy used in the transmission; or that transmission is the most economical in which one-half the difference between the selling price and cost of the energy is equal to the value of the energy used over the line."

ELECTRO-PHYSICS AND MAGNETISM.

Approximate Calculation of the Effects of the Capacity of Coils.—In a highly mathematical article by Mr. Cauro in the "L'Eclairage Elec.," March 23, he developes mathematical expressions for calculating the electrostatic capacity of bifilar coils, such as are used in resistance boxes; he states that the capacity of such coils can have an appreciable effect, giving them an apparent negative self-induction; he discusses the ordinary winding, the Chaperon winding and a new system in which the wires are wound from left to right in one direction, then brought back straight, to the beginning of that layer, and parallel to the axis, then wound in another layer in the opposite direction to the first, and so on throughout the whole winding; the capacity of the Chaperon winding as compared with this one appears to be as 4 to 3.

Optical Rotation of Ions.—The Lond. "Elec. Rev.," April 5, notices briefly a paper by Mr. Walden in the "Zeit. f. Phys. Chem.," Vol. 15, p. 196, on this subject. From observations with certain organic acids, he concludes that the undissociated molecule possess a somewhat greater rotatory power than the dissociated molecule. In experiments with various metallic salts, he was led to conclude that the rotation of their solutions is dependent on the number of active ions, and at complete dissociation in equimolecular solutions, the rotations of different salts containing the same active acid ion, are equal. The molecular rotation of an electrolyte of two active ions appears to be equal to their molecular rotations.

Diselectrification of Air.—A short Royal Society paper by Lord Kelvin and Messrs. MacLean and Galt is reprinted with illustrations in the "Lond. Elec. Rev.," April 5. They describe some more or less successful attempts to filter electrified air through fine wire gauze.

New Researches Regarding the Phenomenon of Kerr.—An article by Mr. Wind from the "Wied. Ann.," February, regarding the phenomenon of the rotation of the plane of polarization by reflection from the surface of a magnet, is abstracted in "L'Eclairage Elec.," March 23.

Division of the Science of Electricity.—Mr. Maycock in a short article in the Lond. "Elec. Rev.," April 5, discusses briefly the divisions and subdivisions of electricity and suggests the following four general divisions: (1) Electricity at rest, or static electricity, or electrostatics; (2) electricity in locomotion, or current electricity, or electrokinetics; (3) electricity in rotation, or magnetism; (4) electricity in vibration, or radiation, or light.

Waves.—The third and fourth lectures of Lord Rayleigh are abstracted briefly in the Lond. "Elec. Rev.," March 29.

Absolute Units.—A system of absolute units for physical quantities is described by Mr. Clavenad in "L'Eclairage Elec.," March 23.

Electrostatic and Magnetic Circuit Analogy.—In an article by Mr. Taylor in the Lond. "Elec. Rev.," March 29, he discusses a number of points regarding the magnetic circuit and in a few cases gives electrostatic analogies. In studying magnetic circuits a most important step is to recognize that the iron is of quite subsidiary importance and that it is the magnetized air in the air gap that is effective; the energy required to produce a given flux is almost wholly expended in magnetizing the air gap, which is therefore the seat of the greater portion of the magnetic energy of the system. In drawing away an armature the energy is supplied by the extension of the lines of force and not by generating more of them; he points out the great similarity between electrostatic lines of strain and magnetic lines of force. He discusses self-demagnetizing force; like a spring in a state of tension, magnetized air tends to resume its normal unmagnetized state, which tendency is called the self-demagnetizing force of a magnetic circuit; when there is no air gap in a magnetic circuit, this force is very feeble; he makes an analogy with lines of conduction in fluids and the self-demagnetizing force of a bar magnet. Regarding the nature of magnetism he believes it highly improbable that the state of being magnetized consists merely of a sort of spinning or rotational movement in or of the ether, and that the energy is therefore wholly kinetic, for if this were the case it would be difficult to see how a self-demagnetizing force could exist.

Magnetic Rotation of Hydrocarbons.—A recent paper by Dr. Perkins read before the Chemical Society of London, is noticed briefly in the Lond. "Elec. Rev.," April 5. He shows that the magnetic rotations of the olefines do not differ from those of the paraffins to quite such a large extent as do other substances correspondingly unsaturated; there are some exceptions, however, which he duly calls attention to; the molecular rotations, speaking generally, which involve both density and specific rotation, exhibit great regularity.

Secular Variation of the Earth's Magnetism.—A recent German publication by Dr. Bauer is noticed briefly in "Elec. Eng.," April 17. He constructed the curve described in the course of centuries by the north end of a free magnetic needle from data of 24 stations distributed over the globe and from the result he established a law governing the direction of the curve; this law is briefly that the north end of a needle moves in the direction of the hands of a watch in consequence of the secular variation. He believes that it has not yet been proved that the earth actually possesses a common secular variation period.

Capacity of Conductors Carrying Currents—A translation in abstract, giving some of the formulas, of the paper of Mr. Vaschy, which was abstracted in the Digest, [Feb. 9, is published in the "Elec. Rev.," April 17.

ELECTRO-CHEMISTRY AND BATTERIES.

Secondary Batteries.—The Lond. "Elec.," April 5, gives a translation of a paper by Mr. Poincare from the "Comptes Rendus" Vol. 120, No. 11. He suggests overcoming the defects of the ordinary lead accumulator by using as electrodes metals in a liquid state, as mercury for instance; an acid electrolyte cannot be used as the hydrogen would be wasted, but with a salt of an acid there will be formed at the cathode an amalgam, the mercury being the anode; the most interesting results were obtained with the alkaline salts of the haloids; perfectly reversible batteries mostly of about two volts were obtained but the chlorine or bromine which combines with the positive mercury forms a layer of high resistance and the efficiency is therefore not good; with iodide of sodium the results were quite different; the solution should be sufficiently concentrated, the density of the current not too great, and the positive electrode larger than the negative, in which case no deposit is formed on the anode; the two electrodes of such a battery remain entirely metallic after the charge; the only loss is a small amount of sodium deposited by the current; the ampere-hour efficiency may not exceed 90 per cent. but the watt-hour efficiency is nearly the same, the rate of discharge being a matter of indifference; the E. M. F. is 1.85 volts and the capacity per pound is about the same as that in lead accumulators, which he gives as 4.5 ampere-hours per pound; he shows that all the chemical energy given to the cell is given out again as electrical energy. This battery is only of theoretical interest, and he admits that it could not be used commercially in that form owing to the high price of the materials, the difficulties in using liquid electrodes, and keeping the amalgam from contact with the liquid; the latter can be accomplished "by a device similar to that employed in the batteries with rolled up electrodes."

Purification of Water by Electrical Processes.—A brief article in the Lond. "Elec. Rev.," March 29, divides the processes into two classes, those in which water is electrolyzed, liberating oxygen, and those in which solutions of salt are electrolyzed, producing certain germicidal substances; in each, substances are produced which act chemically on the impurities; it is not likely that the first of these could ever be realized in the water supply of a great city; regarding the second process it questions the desirability of treating a city's water supply with a powerful and soluble disinfectant unless it is possible by precipitation to eliminate every trace of the hypochlorite after it has done its work; the second process, however, is extremely useful in the disinfection of sewage. The lines upon which electrical engineers have hitherto sought the solution of the problem of the purification of water may not give promise of much result.

Theory of Electrolysis.—The Lond. "Elec. Rev.," March 29, in calling attention to the recent article of Prof. Bucherer in THE ELECTRICAL WORLD, Feb. 2, p. 138, states that he does not agree with the modern view of electrolysis as represented by Nernst's theory of a solution tension, when he states that the potential difference between a metal and its solution is due directly to the relation of the partial pressure of the metallic vapor with which it participates in the equilibrium and the sublimation pressure of the immersed metal.

Electrochemical Equivalents.—Mr. Fitzgerald in the Lond. "Elec. Rev.," April 5, criticises the table of equivalents given in Dr. Keith's recent paper (see Digest April 6 and 13) intimating that there is an error; he gives a table of the electrochemical equivalents of hydrogen and silver based on each of four different fundamental values.

Electrolysis of Gold.—The discussion of Dr. Keith's paper is published apparently in full in the Lond. "Elec. Rev.," April 5.

In a communication to that journal, March 29, Dr. Keith claims that electrolysis, from its two Greek derivatives, means the dissolving, loosing or setting free of a substance by means of electricity, and refers to Webster who speaks of the electrolysis of silver. In the issue of April 5, Mr. Andreoli criticises the title of the paper, saying that gold cannot be electrolized, as an electrolyte must be a body which can be decomposed. He also states that Dr. Keith cannot claim to be the

original discoverer of the electronegative property of mercury to gold, which he shows by quoting from a publication by Skey dated 1875.

Plating Aluminium.—The Lond. "Elec. Rev.," April 5, notices briefly a paper by Mr. Goettig in the "Ber. d. Deut. Chem. Gesellsh." Vol. 27, p. 1824, in which he states that he can obtain a good deposit of several different metals by immersing aluminium in such a solution of the metal as will not deposit by simple immersion and then rubbing the surface with a brush made of wire of some electropositive metal; the deposit is more rapid when the aluminium is relatively most electronegative; copper is deposited from copper sulphate by rubbing the aluminium with tin foil; tin, from aluminium stannic chloride by rubbing with brass wire; he intends to apply the process to other metals besides aluminium.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Apparatus for the Analysis of Alternating Currents.— In the Lond. "Elec.," April 5, Mr. Hicks describes and illustrates an apparatus somewhat similar to that recently described by Dr. Fleming (see Digest March 9 and 16) which he constructed and used some time ago. The synchronizing motor resembles the Mordey alternator; after some trouble he overcame difficulties by fixing the instrument vertically with the lower end of the shaft pivoted; the dimension are given; it will analyze simultaneously both primary and secondary amperes and volts in a transformer, the currents being measured by the volts at the ends of a non-inductive resistance; the motor revolves a commutator in the form of a large disc around which different sets of brushes may be adjusted to any different positions; a condenser is charged repeatedly and is then discharged, by the action of the brushes, through a galvanometer as a direct current; by means of different sets of brushes on different parts of the commutator, the volts and amperes of the primary and secondary circuits are measured simultaneously; to start the motor, a connection is made with the brushes by means of which the current is commutated and it therefore starts as a continuous current motor; when the desired speed has been reached the alternating current is switched on and if it then falls out of step the switch is turned on again for a moment. By running the machine on end he believes there is no doubt that permanent magnets will suffice. A number of curves taken with his instrument are given.

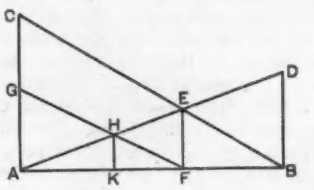
Specific Resistance of Some New Alloys.—"L'Eclairage Elec.," March 23, publishes some extracts from an article by Mr. Van Aubel from the "Jour. de Phys.," Vol. 4, p. 72. The following are some of the results for the alloy kruppin: a wire was heated during several hours to 150 degrees C. then during two hours to 200 degrees C.; the specific gravity was 8.107; the specific resistance at 18 degrees C. in microhms per cm and square cm cross section, was 84.7 or only about 10 per cent. less than that of mercury; the temperature co-efficient is given for a number of different ranges averaging somewhat over 0.0007 which is nearly twice that of German silver; it is said that this material will stand a temperature of 600 degrees C. without suffering any change in structure. The results are also given for a number of patented nickel alloys made by Pleitmann, Witte & Co.; the specific resistance varies between 40 to 53; the temperature co-efficient of some is negative and in all is exceedingly small, averaging less than a tenth of that of German silver; one of these alloys has a higher resistance than manganine and a lower co-efficient of temperature.

Researches with the Induction in Cables.—Dr. Breisig's article (see Digest last week) is continued in the "Elek. Zeit.," April 4; the present portion refers to telephone cables; among his conclusions he states that encircling the wires of a telegraph cable with a shield of tin foil or lead, will not protect them in a measureable degree against induction from neighboring circuits used for Hughes or Morse instrument; one of his experiments shows the very large dimensions which the metallic shield must have in order to protect the wires appreciably against induction; on the other hand the measurements have shown that the metallic shield in telephone cables answers its purpose; the protecting action begins at a relatively small number of impulses and for those occurring during a conversation there is a reduction of the co-efficient, and with it approximately also of the induced current, of about 25 per cent. of the value which it would have if there were no metallic shield.

Calibrating Large Ammeters at Stations.—Owing to the variations of the current sent out in regular service the calibration of large ammeters in stations is difficult or impossible when a Thomson balance or a Siemens dynamometer is used as a standard. A method used in the Louisville electric light station with complete success, by means of which the difficulties are overcome, is described by Mr. Speed in the "Rose Technic" for April. The ammeter and the standard are connected in series with the large dynamo at a time when the dynamo is not carrying a load; the bus bars are short-circuited by twisting heavy wire around them; the shunt field winding circuit is opened near the rheostat and a small water resistance is put into that circuit; the series coils of the compound generator are short-circuited by a heavy jumper which, however, must not be too heavy, as a small amount of compounding is necessary; the current may then be run up as high as desired by diminishing the water resistance; a machine thus arranged usually gives 10 to 20 per cent. of its current with the shunt field open. He gives an example of this method in which a 550-volt 700-ampere generator was used, the calibration requiring one hour and fifteen minutes including the adjustment of the ammeter, which was found to read incorrectly.

Combined Ammeter and Voltmeter.—An instrument is briefly described and illustrated by Mr. Parker in "Elec. Power" for April; it consists simply of a D'Arsonval galvanometer with two coils placed at an angle with each other, both rigidly fixed to the same axle; one is placed in series with a high resistance, and the other shunts a low resistance; it can therefore measure both volts and amperes; the coils may be placed in parallel or in series "so it may be possible to have the instrument also indicate watts and ohms."

Graphic Calculation of Resistance.—The following simple method for finding graphically the combined resistance of two or more circuits in parallel, is described by Mr. Wines in the "Elec. Eng.," April 17; he



also gives the proof. In the adjoining figure AB is any convenient length, AC is laid off equal to one of the two resistances and BD is made equal to the other; draw CB and DA and from their intersection draw EF; then the length of EF is equal to the combined resistance of these two. If there is a third resistance, as AG for instance, then as EF is the combined resistance of the other two, carry out the same construction, which will give the distance HK, the length of which will be the combined resistance of all three. The same process may be carried out for any number of resistances.

Apparatus for Measuring Difference of Phase.—The article of Mr. Derr, abstracted in the Digest, April 6, is reprinted with the illustrations in the "West. Elec.," April 13.

Measuring the Variation of Internal Resistance of a Cell with Current.—Prof. Carhart's recent article, abstracted in the Digest, March 30, is reprinted in the "West. Elec.," April 13.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Microphone.—A new form in which plastic carbon is used, is described and illustrated in the "Elek. Zeit.," April 4.

Annunciators.—A new form is well illustrated and described in the "Elek. Zeit.," April 4; it is intended to indicate the number of times the signal bell has been rung; in a number of hotels one, two or three rings indicate each a different signal and the object of the present annunciator is to indicate which of these signals has been given; the annunciator contains a disc pivoted at its centre and rotated a quarter of a revolution for each ringing of the bell thereby uncovering the number corresponding to the signal.

Government Telegraphy.—In a brief article in "Elec. Power" for April by Mr. Delany, he states that he can see no good reason why the government should not own the telegraphs. He goes further and asks why the government should carry our letters by train at 30 miles an hour instead of by telegraph; there are about 30,000 letters exchanged between New York and Chicago daily, and assuming that they average 50 words each, all could be telegraphed over two copper wires the size of a lead pencil; with the automatic chemical method 1,000 words per minute can be recorded perfectly between New York and Chicago over a one-ohm-per-mile wire; messages can be perforated at the rate of 25 word per minute and typewriters can print from the receiving tape at the same speed; at this basis letters of 50 words could be perforated, transmitted, printed, and delivered through the mails at a cost of about 5 cents; with the present hand transmission, companies cannot telegraph for less than existing rates; he believes that hand working and great numbers of cheap iron wires will soon pass, and that automatic systems and a few big copper wires reaching out to the principal cities will carry all the correspondence.

Machine Telegraphy.—In a short article by Mr. Delany in the "Teleg. Age," April 16, he expresses his opinion quite decidedly to the effect that machine telegraphy is the coming method of transmitting telegraph dispatches; "cheap iron wires, overloaded poles, with an enormous repair expense, should and will disappear quicker than the horse car when the movement once begins."

Submarine Telegraph of the World.—The "West. Elec.," April 20, reprints the statistics recently compiled by the International Bureau at Berne.

How Cables are Repaired.—A profusely illustrated article of a semi-popular nature referring to submarine cables, is begun in the "Teleg. Age," April 16.

Telephony.—"Elec. Eng'ing" for April, begins the publication of a serial on telephony by Dr. Wietlisbach. It is claimed that every feature in the telephone exchange and in the science of telephony will be covered in this illustrated serial. The present portion discusses sound vibrations and gives a general description of the telephone.

Railroad Signalling.—A recent paper by Mr. Gibbs on the "Modern Practice in Signalling" is abstracted in the "Eng. News," March 14; the discussion is abstracted in the issue of April 11.

MISCELLANEOUS.

Carbide of Calcium.—The "Elec. Age," April 13, contains an abstract of a recent article by Mr. Wood from the "American Gas Light Journal." According to the Electric Gas Light Company, who controls the manu-

facture of this material, an electric horse power in the form of incandescent lights compared with the same amount of energy in the form of calcium carbide gas would be about as 7 to 11 in light, but he adds that these deductions should be received with caution until they have been verified; this difference is not sufficient to enable steam generated carbide and acetylene to compete with the electric incandescent light; when the latter have an efficiency of 3.5 watts per candle the lights will be equal. The lowest prime cost of an electric horse power from a central station is four cents hence, the cost of power for a ton of carbide will be nearly ten times that estimated by the company, which is 50 cents per horse power per year; the statements of the company he says have never been verified by any one not working in their interest. He gives an estimate in which he states that one electric horse power produces 10 pounds of carbide in a ten-hour day; he believes it is doubtful if the useful effect can be increased to much over 50 per cent. of the materials charged, and the waste in the furnace must necessarily be large. He makes an estimate for a 2,000-hp steam plant producing 20 tons daily; with coal at one dollar per ton the cost of the carbide will be $19.70 per short ton; with a water power plant on a basis of five dollars per horse power per year it will cost $16.10 per ton; with contemplated improvements it may be possible to produce the carbide for a commercial price of $24 per ton F. O. B. but only under extremely favorable conditions. He gives the numbers and dates of the three Wilson patents. The same journal reprints the portion of Mr. Perry's paper from the "Eng. Mag.," for April, regarding the manufacture of this material in central lighting stations.

Hardening of Steel.—A translation, in abstract, of the recent paper of Mr. Charpy abstracted in the Digest last week under "Temperature of Transformation of Iron and Steel," is published in the "Eng. & Min. Jour.," April 13.

Patents.—"Elec. Eng'ing" for April contains an article by Mr. Smith, reprinted in the "Elec. Rev.," April 17, on "Patent laws; the Inventor; the Public"; another by Mr. Hill on "The Mechanical Expert Witness in Patent Causes"; another by Mr. Smith on "Expert Witnesses in Patent Causes."

Municipal Industrial School.—"Elec. Eng'ing" for April contains an article by Mr. McMynn; also an editorial by Mr. DeLand on "Character Forming Schools."

New Book.

THE PRACTICAL APPLICATION OF DYNAMO ELECTRICAL MACHINERY. By Carl K. MacFadden and William D. Ray. Second edition, revised. Chicago: Date & Ruggles. 167 pages, 38 illustrations. Price, $1.00.

This is one of the numerous books written with the design to teach technical subjects in a juvenile style to "practical" men, and is perhaps somewhat better than most of its kind. The writers labor most conscientiously to render clear to the reader the mysteries of Ohm's law which is declared to be "without doubt the foundation of all electrical knowledge," and from which are obtained "all of the more complex formulas known to the Electrical Engineers." The various chapters contain, along with cuts and descriptions of series, multiple and multiple-series circuits and other time-honored subjects, much useful information, particularly in those portions where the authors relax their pedagogical attitude and deal with everyday matters of practical interest.

While the book is dated last year, portions of the chapter on street railways are apparently some years in arrears; the "Sprague-Edison" method of street car motor control, for instance, is illustrated and described at length, and its simplicity stated to be such that "this plan is used by the Thomson-Houston Company on most of its equipments." The writers define inductance as "the magnetism-producing effect of the circuit," and the reason why copper is used for conductors is said to be owing to "its 'conductivity,' that is, its small resistance to the flow of the current"—the implied definition of conductivity being rather unique.

To the reader in search of simple practical information this work will be found useful, though he should bear in mind that some of the subjects treated are much less difficult than might be supposed from the amount of space devoted to them.

Electric Flash Light.

An interesting application of photography was recently made at the Metropolitan Opera House in New York, a photograph of the vast audience assembled to hear Alvary's 100th performance of the title role of Siegfried being taken by flash light. This was the largest photograph ever taken by flash light and proved to be a complete success. Electricity played an all-important part on this occasion, for by its means 35 piles of magnesium powder were simultaneously exploded, making one gigantic flash lasting less than one-fortieth of a second.

Many attempts have been made to obtain photographs of large interiors and groups of people. Very little success has attended these efforts, owing to the difficulty of obtaining an intensely brilliant light in the shortest possible space of time. So well were the many obstacles overcome in the photograph of the Metropolitan Opera House that not the slightest movement can be noticed in the audience of 3,500 people.

Heretofore it has been customary to use a quantity of magnesium powder stretched out in a long pile. This was ignited with a fuse, or by blowing the flames of an alcohol lamp directly against the powder. These methods have answered for groups or interiors. The task of photographing a large, constantly moving audience in a brilliantly lighted auditorium was never accomplished until the aid of electricity was invoked. The apparatus for producing the flash was constructed by Mr. T. D. Bunce, of the Storage Battery Supply Company, 239 East 27th street. The photographic work was done by Mr. E. Marx.

Many experiments have been made by Mr. Bunce and many smaller pictures successfully taken. But in a photograph of this kind many things had to be considered, such as quantity, speed, projection and distribution of the light. A small pan of powder may be exploded with sufficient speed to produce an instantaneous exposure. For an interior the size of the Metropolitan Opera House such a quantity of powder was required that if it had been ignited in one mass the exposure would have been too long, as well as having the great objection of the light coming from one point. Electricity solved the problem. It produced a simultaneous discharge of the powder, allowed of proper distribution, and the safe and unseen operation of the flash.

The apparatus consisted of an iron frame, supporting seven pans upon the sides and top. In each pan were placed five specially constructed fuses that were in connection with a storage battery behind the scenes. The camera, holding a plate 18 by 20 inches, was placed in the centre of the frame. Behind this were white cardboard screens. Around each fuse was placed a pile of magnesium composition especially prepared by Mr. Marx.

At the close of the first act of the opera the apparatus was quickly placed on the stage. The curtain rose, a hurried focus was taken, the switch closed and the intense light flashed out. The curtain descended and the photograph of 3,500 people was taken before they knew it. The picture was perfectly successful, as may be seen from its reproduction in *Harper's Weekly* of April 3.

A Combined Regulating Socket and Lamp.

Patents have recently been granted in this country, Canada and England to Mr. C. A. Hussey, of 680 Broadway, New York City, upon the regulating lamp socket herewith illustrated, which possesses the advantages of being adapted for either alternating or continuous currents, and of containing no choking coil, resistance, or other current-consuming device.

The regulation is obtained by providing the lamp with two filaments as shown in the engraving, and, by means of a suitable switch in the socket, throwing in circuit one or both of the filaments, as may be desired. In a lamp rated at 16 cp each filament gives 8 cp, the full capacity of the lamp being obtained by switching both filaments in parallel. For night service, the filaments are connected in series.

NEW REGULATING SOCKET AND LAMP.

New Panel Board and Box.

The accompanying engravings illustrate some new forms of cut-out boxes and distributing board recently perfected by T. J. Murphy & Company, of 136 Liberty street, New York.

The improvement in the tablet board consists in so arranging the cross connections as to locate the two connection lugs for any given branch circuit, side by side, as shown by Fig. 1, instead of placing all the positive connections on one side of the board and the negative lugs on the opposite side.

The feature of the cut-out boxes is the method of leading in the wires. A small iron nipple bushed with insulating material, shown at the top

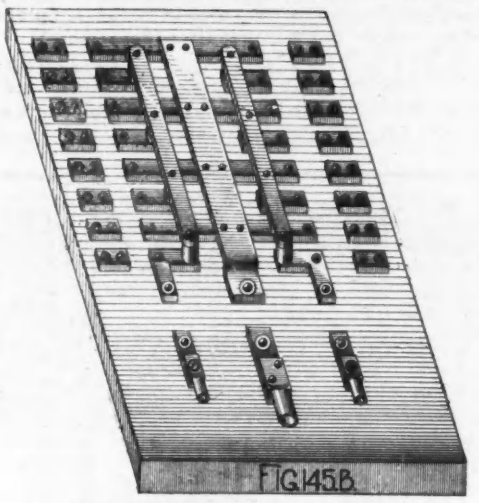


FIG. 1.—NEW PANEL BOARD.

of Fig. 2, is secured by lock-nuts in a hole in the side of the box, and the wire is brought through the nipple. The end of the conduit is brought up to the end of the nipple, and the two joined by a coupling, forming a continuous covering for the wire without recourse to special devices or troublesome fitting. On the right of Fig. 2 is shown a plain cut-out box equipped with leading-in nipples, and on the left a compound box with tablet board and nipples complete. This latter form of box is designed to meet the views of those engineers who prefer plenty of "lee-way" between the entering holes and the connection lugs for the purpose of making changes in connections if desired, or leaving slack in the ends of the wires to provide for the possible shortening by

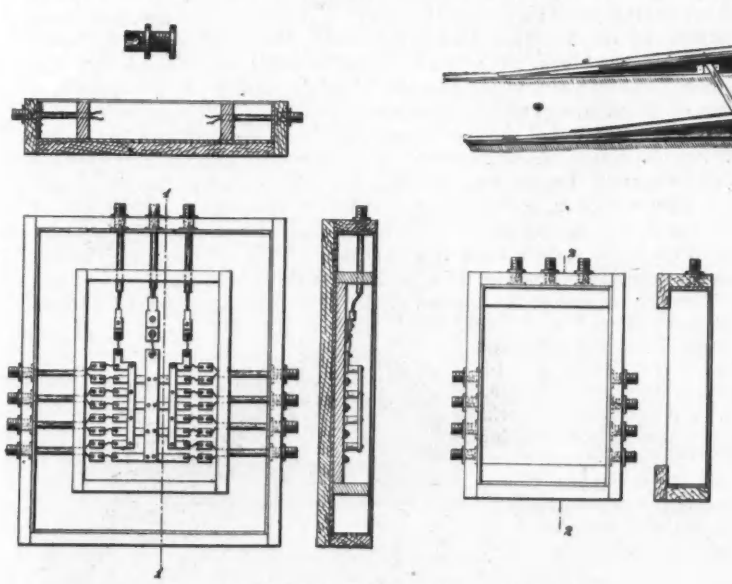


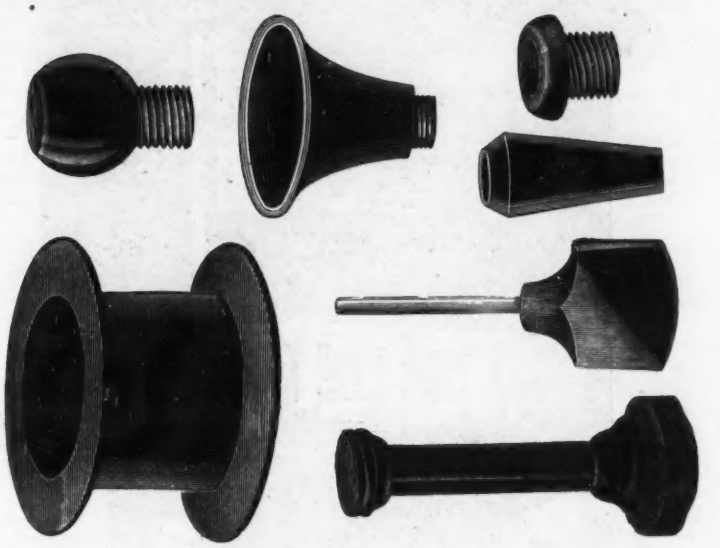
FIG. 2.—IMPROVED DISTRIBUTING BOXES.

accidental breakage, etc. If desired, the chamber formed between the inner and outer walls of the box may be filled up flush with an insulating compound.

A Substitute for Hard Rubber.

Among the substitutes for hard rubber which has passed largely into use for electrical purposes is electrose, which material is manufactured in many forms, several of which we illustrate, by the Electrose Manufacturing Company, 216 William street, New York. Of the many advantages of this material for electrical work one is that it will not tarnish metal with which it is contact, no sulphur being used in its vulcanization. Though much cheaper than hard rubber, it possesses the highest insulation properties; it can be readily moulded into any shape and when colored does not fade. Possessing a high polish and great strength electrose is particularly adapted for telephone receivers and other fittings, for lamp socket nipples and handles and other purposes where these qualities are desirable.

A valuable property of this material is that changes of temperature do not affect it, so that when used for telephone cases the adjustment of the diaphragm and magnet are not affected. It will also resist the



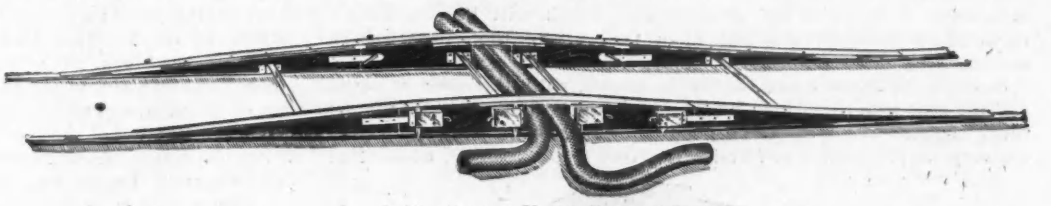
ELECTROSE SPECIALTIES.

action of the weaker acids and alkalines and withstand an elevated temperature.

Portable Hose Bridge.

A most useful piece of apparatus for street railway purposes has recently been placed on the market by the Metropolitan Electric Company, Chicago, in the form of a portable hose bridge, whose employment will obviate annoying delays to the public, with accompanying inconveniences and losses of fares to street railway companies.

The bridge is sixteen feet in length, each side being in three sections. These sections are quickly connected by means of a clasp, which holds



A PORTABLE HOSE BRIDGE.

the parts firmly and rigidly together. Braces hold the two sides securely in place, while ratchet spikes, held by strong springs, hold the parts to the ground and rail. The parts are all made of such strength and materials that the heaviest motors and trailers can be easily carried. The bridges will fit any kind of rail and are made for any gauge. They can be placed in position by one man inside of three minutes, and can be carried to the scene of a fire either in a car or a "hurry-up wagon." Two lines of the largest fire hose made can be used through the bridge. The connection at each end with the rail is close and the rise of a car in going over the bridge is so gradual and slight as to be hardly perceptible. The bridges are so sturdy that the makers guarantee them for a minimum life of ten years.

Accumulator Traction in France.

An electric tramway on the accumulator system has recently been completed between Nice and Cimiez. The generating plant comprises two 50-hp steam engines, driving two dynamos giving 200 amperes at 200 volts. The accumulators employed are of the Laurent-Cély type, supplied by the Société du Travail Electrique des Metaux. Each car is provided with 90 cells, and two motors connected to the axles by gear wheels.

An Electric Mountain Railway.

A company is being formed to construct an electric rack railway up the Sonnenberg at Lucerne, under an 80-years concession granted in June, 1893. The line will be 3.8 kilometres long, the terminal station being at an altitude of 2,555 feet. The necessary electric energy will be supplied from the Rathhausen central station, the current being conveyed along an underground conduit. The line will be of the metre gauge, the speed ranging between 9 and 12 kilometres per hour.

The Phœnix Transformer.

In placing upon the market their new Phœnix transformer, which we illustrate herewith, the Louisville Electrical Works, of Louisville, Ky., claim to be exploiting an apparatus which will be well worth a thorough examination and test upon the part of the central station manager,

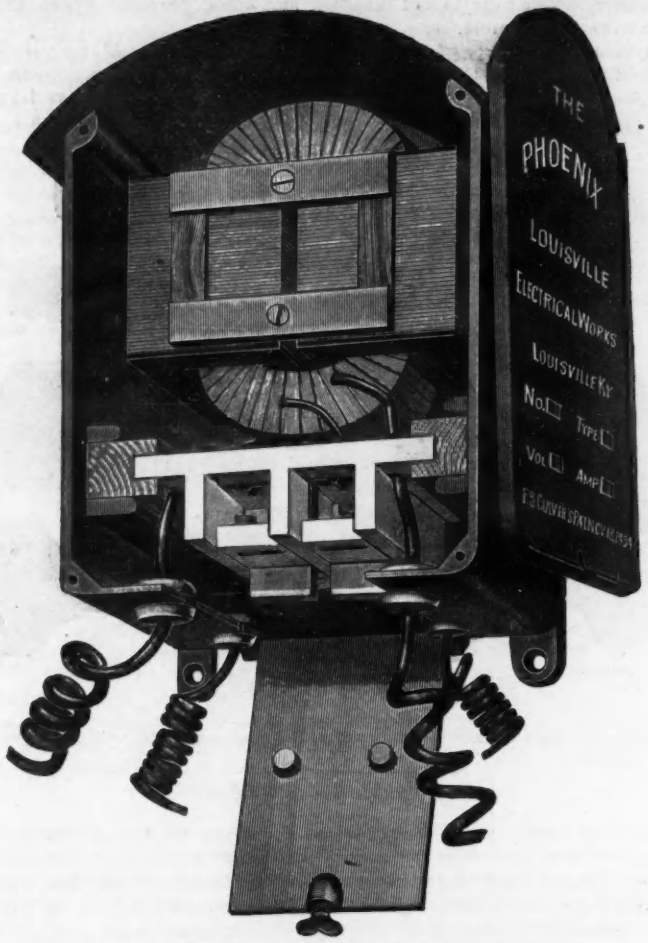


FIG. 1.—INTERIOR VIEW OF TRANSFORMER.

In Fig 1 the Phœnix transformer is shown, with the cover removed and the door lowered, which view shows the coil, core and terminal block and fuse device in their positions. Fig. 2 gives a clear idea of the very simple method of forming the core about the coil, while Fig.

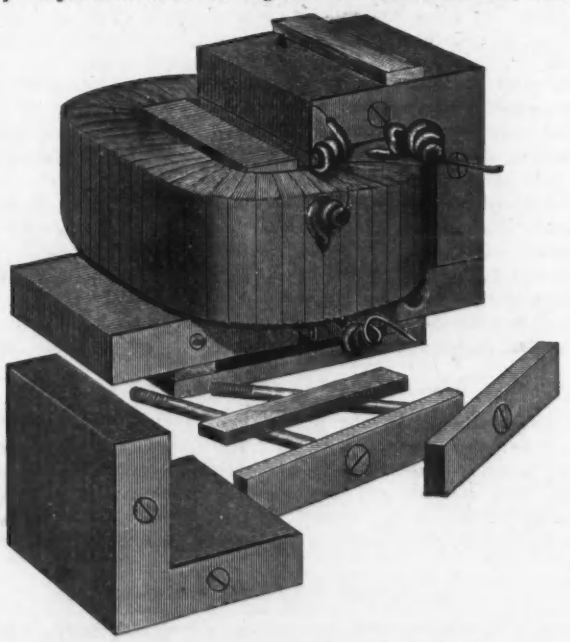


FIG. 2.—CORE PARTIALLY BUILT UP.

3 shows the construction of the terminal block and fuse plug. The cases are strong, durable and well ventilated, besides being thoroughly waterproof. At the bottom of the case is a small hinged door, secured by only one thumb screw, through which the fuse plugs are readily and safely reached; adjoining the door are four slots, in which are freely and loosely placed the porcelain insulators, through which the leading-in wires are run. The use of a porcelain insulator in this position and for this purpose is a new departure, and an improvement upon the usual rubber insulators, which are so readily broken.

The core is formed of L-shaped laminations, tightly bolted together in four interchangeable blocks or sections. The core sections, after having been assembled about the coil, are rigidly and securely bolted together by means of two long screws running through wrought iron clamps, which latter are thoroughly insulated from the core. Through special means of punching and treating these laminations and pressing the core together the best magnetic joints obtainable are secured. The core and coil are secured in position in the case in a very simple and effective manner, and to remove the same requires the removal of simply two cap screws.

The porcelain terminal block and fuse device are secured in the case between blocks of treated wood, held between projections on the inside of the case. The fuse plugs are all alike and interchangeable, and are

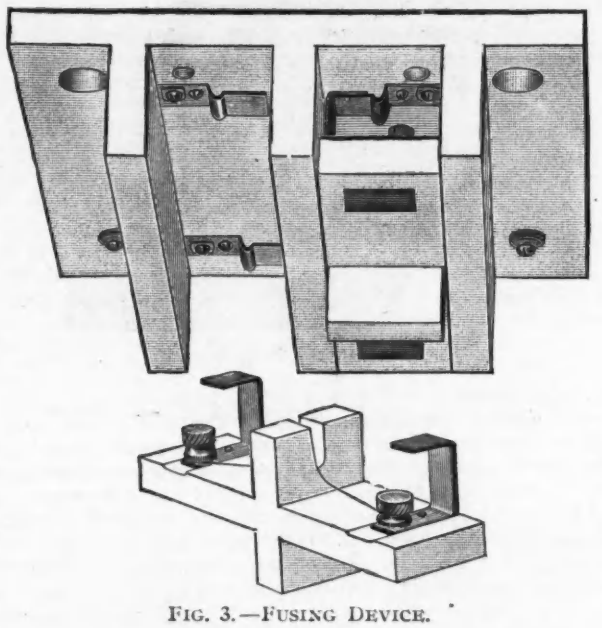
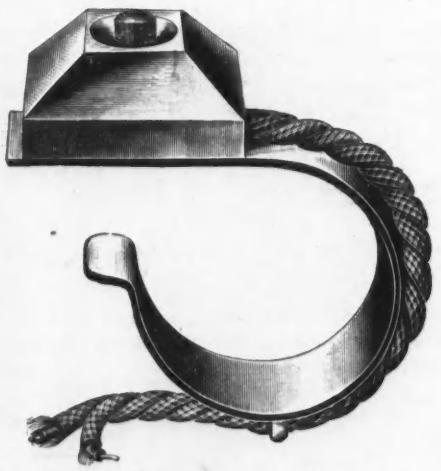


FIG. 3.—FUSING DEVICE.

fitted with blades, which slide under contact pieces upon the lower surface of the terminal block, the plug sliding between the walls formed on the block. The fuse is secured under two thumb nuts and passes through a slot in a bridge of porcelain formed on the upper surface of the plug, and which effects the destruction of the most serious arc.

The construction of the fuse plug makes it as effective as a jack-knife switch as a circuit breaker, and not only causes it to be absolutely safe for the lineman to handle, but through the blowing of a fuse it cannot possibly be broken, having an open space at each end for the escape of the gases formed. When the door of the case is closed, the two lugs upon its inside surface move into position in front of the thumb pieces on the fuse plugs, making it impossible for them to become loosened.

Through the use of the highest grade of material, the proper proportioning thereof and the peculiar method employed in forming and securing together the core, the Louisville Electrical Works claim that they are enabled to guarantee for their transformers the very closest regulation, the highest efficiency, and the least leakage, and are willing to have any one put them to a thorough and complete test for the determining of the correctness of their statements upon these points.



COMBINED CLIP AND PUSH.

Combination Clip and Push Button.

Among the new electrical devices recently placed on the market by Huebel & Manger, 286 Graham street, Brooklyn, is a combined clip and push button, illustrated herewith. As will be seen by a glance at the cut, the device is complete in itself, and adaptable for many purposes where a temporary connection to a call bell is desired. It can be easily and quickly attached to any piece of movable furniture, such as card and chess tables, an easy chair, invalid's couch, etc.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, April 20, 1895.

THE ELECTRICAL STOCK MARKET continued uneventful again this week, not even the mildest sort of enthusiasm being aroused in any quarter. Close students of American Bell say that the decline in that stock is due to the reports of reductions in rates throughout the country, and claim that there has not been so much reduction in rates as a change in the system of charges from the flat rental system to a so-called "measure" basis. Be that as it may, the fact remains that the stock has been flat and unsteady for some time past, a sudden but slight advance yesterday and to-day being the sole approach to anything like a rally.

GENERAL ELECTRIC displayed a rather unusual degree of activity and firmness this week, over 12,000 shares being dealt in within 15 minutes after the opening on Wednesday. Though these transactions were made at less than 33, the stock has otherwise remained pretty steady between 33 and 34 during the week.

ELECTRIC STORAGE has maintained a very steady aspect for quite a while, and appears to be steadily gaining in favor on both New York and Philadelphia floors.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	97¼	98⅛
" " " Brooklyn	100	..	108
" " " Boston	100	124	125
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	29	30
General Electric	100	33½	33¾
General Electric, pref	100	63¾	64¼
Westinghouse Consolidated, com.	50	33½	34½
" " pref	50	..	52

BONDS.

Edison Electric Ill., New York	100	105½	105⅝
Edison Electric Light of Europe	100	75	85
General Electric Co. deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	180	181
American District Telegraph	100	30	40
American Telegraph & Cable	100	91	..
Central & South American Telegraph	100	117	120
Commercial Cables	100	141	..
Erie Telephone	100	50	51
Gold & Stock Telegraph	100	105	..
New England Telephone	100	66	66⅛
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	..
Western Union Telegraph	100	88⅝	88¾

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	17	17⅛
Binghamton RR. com	100	100	..
Brooklyn Traction	100	9	11
" " pref	100	..	53
Buffalo St. Ry	100	66	69
Cleveland City Ry	100	68	70
Cleveland Electric Ry	100	59	60
Chicago City Ry	100	305	315
Columbus St. Ry	100	46	49
Consolidated Traction of N. J	..	30	33
Electric Traction, Philadelphia	50	75½	76½
Long Island Traction	100	9	9¼
Louisville St. Ry. com.	100	37	39
" " " pref.	100	87	88
Metropolitan Traction, Philadelphia	100	89⅝	90
New Orleans Traction	100	15	18
" pref.	100	56	60
North Shore Traction	100	..	..
" " pref	100	74	83
People's Traction $30 pd	25	59	59½
†Philadelphia Traction	50	82¼	82⅜
Rochester St. Ry	..	38	..
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	64¾	65
" " pref	100	88	..
Worcester Traction	100	..	13
" " pref	100	77	80

BONDS.

Buffalo St. Ry. 1st con. 5s	100	101	..
*Binghamton Railroad Co. 5s	100	99	100
*Columbus St. Ry. 1st 5s	100	9	..
Rochester St. Ry. 1st. 5s	100	95	97
*Union Ry. 1st. mtge 6s	100	105	108
*Westchester Electric 1st. mtge. 5s	100	98	101

* With accrued interest.

† Ex-rights.

BALTIMORE, METROPOLITAN & PEOPLE'S TRACTIONS are all three showing somewhat bullish tendencies, probably due, in a measure, to the increase in traffic along with the approach of spring weather, and partly owing to a general improvement in the business over last April. Since April 1, Baltimore's Traction's earnings have increased over $300 a day; for the first nine days of the month Metropolitan's earnings were over $18,000 in excess of last year's business for the same period, and it is understood that the increase in the earnings of People's Traction, as compared with this season last year, is averaging about $3,000 a day.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD.
253 BROADWAY, NEW YORK, April 22, 1895.

MR. J. C. HOBART, of the Triumph Electric Company, Cincinnati, was in New York during the week, and reports that he finds everywhere an improvement in business. His own company finds it necessary to run day and night to fill orders.

CANADIAN NOTES.

OTTAWA, April 20,

HALIFAX, N. S.—The legislature has thrown out the "Bondholders' Electric Street Railway bill."

QUEBEC.—The Quebec Street Railway Company is asking permission to introduce the storage battery system.

TORONTO.—The city's share of the electric street railway receipts for March was $5,609, and $16,266 for the quarter.

ST. JOHN, N. B.—Tenders are called for from persons willing to undertake the lighting of the streets of this city with electric light.

MATTAWA, ONT.—The Mattawa Electric Light & Power Company, with a capital of $80,000, has just secured a charter from the Ontario Government.

ST. MARTIN, QUE.—Negotiations are pending between the Mountain Park and Island Electric Railway to run a line through the towns of St. Martin and St. Rose.

OTTAWA, ONT.—The Posclean & Carleon Company, capital $100,000, have started the construction of their new works in this city. The factory will be 185 by 150 feet.

HULL, QUE.—The Deschenes Electric Company, with a capital of $60,000, is applying to the Dominion Government for a charter to manufacture electricity for light, heat and power.

HAMILTON, ONT.—The Hamilton Lake Erie Power Company are applying to the Dominion Parliament for power to build electrical works for generating electricity on a large scale.

OTTAWA, ONT.—A number of capitalists of this city have been in Jamaica, W. I., where they are negotiating for franchises to construct electric railways in Kingston and at other points on the island.

OTTAWA, ONT.—It is probable that a conference of the representatives from the Australian colonies and Canada will shortly be held to consider the tenders recently received for laying the proposed Canadian-Australian Pacific cable.

TORONTO, ONT.—The Ontario legislature has passed a bill fixing ten hours a day as the time an employee on electric railways shall work. A strong protest was entered against the section of the bill prohibiting the sale of stock below par. Hon. Mr. Bronson, in reply, said that stock worth 150 per cent. had been transferred at par, enabling certain people to pocket that which should have gone to the benefit of the shareholders at large.

OTTAWA, ONT.—The figures of the tenders received by the Canadian Government for the construction of a cable from Canada to Australia are as follows: Route No. 1, from Vancouver, via Fanning Island and Fiji to Norfolk Island, there to divide, one cable going to New Zealand and the other to Australia, £1,517,000. Route No. 2, from Vancouver to Necker Island and Fiji to Norfolk Island, there to divide, one cable going to New Zealand and the other to Australia, £1,416,000. Route No. 3, from Vancouver via Necker Island to an island in the Gilbert group, there to divide, one cable going by way of Fiji to New Zealand and the other by way of the Solomon Islands to Queensland, £1,303,000. Route No. 4, from Vancouver via Necker Island and the Gilbert and Solomon islands to Queensland only, £1,068,000. Route No. 5, from Vancouver via Necker Island, and Fiji to New Zealand only, £1,291,000. Route No. 6, from Vancouver to Honolulu and there divide, one cable going to New Zealand, the other to Australia, £1,391,000. Route No. 7, from Vancouver via Honolulu, the Gilbert and Solomon islands, to Queensland only, £1,081,000. Route No. 8, from Vancouver via Honolulu and Fiji to New Zealand only, £1,243,000.

General News.

New Incorporations.

THE BELTON TELEPHONE COMPANY, stock $20,000, has been incorporated by N. K. Smith, Charles Smith and others.

THE MONTICELLO MUTUAL TELEPHONE COMPANY, Monticello, Ill., has been incorporated by W. H. Plunk, H. N. Knight and N. W. Hart.

THE UNIVERSAL TELEPHONE COMPANY, Indianapolis, Ind., capital stock $25,000, has been incorporated by H. B. Charles, Robert Martindale and others.

THE GREENVILLE ELECTRIC LIGHT, HEAT AND POWER COMPANY, Greenville, Mo., capital stock $25,000, has been incorporated by E. and Samuel D. Bruckman.

THE PEOPLE'S TELEPHONE COMPANY, New Haven, Conn., has been incorporated by ex-Gov. T. M. Walle, J. E. Bowles, J. Irving and J. J. Lawton. The capital stock is $500,000.

THE INTERSTATE TELEPHONE AND TELEGRAPH COMPANY, Durham, N. C., capital stock $100,000, has been organized with L. A. Carr, president, to manufacture telephones.

THE CLINTON TELEPHONE COMPANY, Clinton, Tenn., has been organized with Dr. R. K. Medaris, president and general manager; J. C. Strader, vice-president, and W. W. Medaris, secretary and treasurer.

THE CUERO TELEPHONE COMPANY, Cuero, Tex., capital stock $4,000, has been incorporated by William Probese, C. L. Stadtler, William Wagner, Lee Joseph, W. K. Rathbone, D. Hunter and Samuel C. Lackey.

THE DELAWARE COUNTY ELECTRIC COMPANY, Chester, Pa., capital stock $1,000, has been organized to supply light, heat and power. The promoters are S. T. Wellman, Upland; W. C. Gray, and O. B. Dickinson.

THE KELLY WATCH COMPANY, Chicago, Ill., capital stock $20,000, has been incorporated to make and sell time pieces, electric devices, etc. The interested parties are Thos. F. Kelly, J. O'Hare and Robt. J. Bieg.

THE WHITE BEAR TELEPHONE COMPANY, St. Paul, Minn., capital stock $10,000, has been incorporated by John L. Pratt, Chicago, Ill.; Jas. L. Brass, James Berlingett, Tracy Lyon and Robert C. Wright, of St. Paul.

THE MUNCY VALLEY STREET RAILWAY COMPANY, Mahanoy City, Pa., capital stock $50,000, has been incorporated. The promoters are Jno. J. Coyle and C. C. Smith, of Mahanoy City, and Chas. U. Brumm, of Minersville.

THE MILWAUKEE INCANDESCENT LAMP COMPANY, Milwaukee, Wis., capital stock $25,000, has been formed to manufacture and deal in incandescent lamps. John J. Reilly, M. J. Reilly and Barney Davis, Milwaukee, Wis., are interested.

THE CHICAGO SUBWAY, ARCADE AND TRACTION COMPANY has been incorporated with a capital stock of $15,000,000, for the purpose of constructing subways in that city and operating a line of cars. The secretary of the company can be addressed.

THE WACO ELECTRICAL SUPPLY AND CONSTRUCTION COMPANY, Waco, Tex., capital stock $10,000, has been formed to buy and sell goods, wares and merchandise by wholesale. W. W. Seley, S. A. Hobson, and A. P. Moore, Waco, are the interested parties.

THE E. S. KAWLY ELECTRICAL CONSTRUCTION COMPANY, Chicago, Ill., capital stock $12,000, has been formed to go into the construction business, install electrical apparatus in buildings and elsewhere, etc. E. S. Kawly, V. Merriam and J. H Weber.

THE ADAMS-BAGNALL ELECTRIC COMPANY, Cleveland, O., capital stock $150,000, has been formed to manufacture and deal in electric lamps, railway motors, electrical machinery, etc. Thos. E. Adams, E. J. Bagnall and Chas C. Hickok are interested parties.

THE HARTFORD LIGHT AND POWER COMPANY, Hartford City, Ind., capital stock $30,000, has been organized. The incorporators are Wm. N. Forbis, Monticello, Ind.; Milton H. Forbis, Cincinnati, O.; Albert Reynolds and Guy E. Reynolds, Hartford City, Ind.

THE BELLE VERNON ELECTRIC LIGHT AND POWER COMPANY, Belle Vernon, Pa., capital stock $1,000, has been incorporated to generate light and power by electricity. Samuel M. Graham, Adolph C. Hamm, and C. F. Eggers, all of Belle Vernon, are interested.

THE TAYLOR ELECTRIC LIGHT COMPANY, Taylor, Tex., capital stock $20,000, has been formed to generate and supply electricity for light, heat and power, and to manufacture and supply gas. Hugh Burns, F. L. Welch and Bernard Garry, of Taylor, are the promoters.

THE ASBURY PARK ELECTRIC COMPANY, Asbury Park, N. J., capital stock $200,000, has been formed to supply electricity for light, heat and power, etc. The promoters are Geo. A. Smook, Jas. M. Ralston, John W. Rockafeller and Harry J. Rockafeller, Asbury Park, N. J.

THE IOWA FALLS ELECTRIC LIGHT AND POWER COMPANY, Iowa Falls, Ia., capital stock $15,000, has been formed to erect, maintain and operate an electric light and power plant. L. B. Bradley, H. C. Miller, J. D. McKay and Z. K. Hoag, Iowa Falls, Ia., are the promoters.

THE AUTOMATIC TELEPHONE COMPANY of Wisconsin, Chicago, Ill., capital stock $500,000, has been formed to maintain and operate telephone service, to supply electric light and power, do wiring, etc. The promoters are J. Harry Theobald, Wm. T. Whipple and Maurice Rosenfeld.

THE ROTH MULTICYLINDER MOTOR COMPANY, Cincinnati, O., capital stock $100,000, has been formed to manufacture and sell gas and gasoline and electromotors, engines and locomotives. The promoters are Gilson W. Roth, H. L. Roth, J. M. Blair, Jos. T. Blair and R. C. Bliss.

THE AMERICAN ELECTRIC WORKS COMPANY, Denver, Col., capital stock $10,000, has been formed to buy, sell, rent, manufacture and repair all kinds of electrical, steam and other machinery. Wm. Thorne, Thomp. G. Walton and Chas. E. Hawkins, all of Denver, Col., are interested.

THE MIDDLEBROOK TELEPHONE COMPANY, Staunton, Va., capital stock $5,000, has been incorporated with John H. Bowman, president; J. Frank Clemmer, vice-president; H. A. Shepherd, secretary; W. W. Sproul, treasurer, to construct a telephone line from Staunton to Lexington.

THE NEW YORK ELECTRIC MOTOR AND VENTILATOR COMPANY, New York, capital stock $30,000, has been formed to manufacture and sell electric motors, appliances, etc. Sidney Green, New York; C. A. Sherman and Lincoln Van Cott, Brooklyn, N. Y., are interested parties.

THE OSBURN ELECTRIC SUPPLY COMPANY, Chicago, Ill., capital stock $12,000, has been formed to manufacture and deal in electrical goods, machinery, supplies, etc., of all kinds, and to carry on a general electrical business. Harry G. Osburn, M. Roy Osburn and Asa W. Waters are interested.

THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY, Richmond, Va., capital stock $50,000, has been formed by Edward P. Meany, Newark, N. J., president, and Melville Egleston, Elizabeth, N. J., secretary, to construct and operate telephone and telegraph lines throughout Virginia.

THE STANDARD TELEPHONE AND ELECTRIC COMPANY, Minneapolis, Minn., capital stock $50,000, has been formed to manufacture telephones and other electrical instruments. S. S. Kilvington, E. W. Batchelder, H. C. Dodge and Geo. L. Scott, of Minneapolis, Minn., are the incorporators.

THE W. H. ELLIOTT ELECTRIC COMPANY, Cleveland, O., capital stock $10,000, has been formed to manufacture, buy and sell all kinds of electrical devices and machinery, etc. Robert M. Fuller, Theodore C. Vollman, Wm. H. Elliott, Alvin A. Piper and Chas. O. Cartright are the incorporators.

THE STANDARD TELEPHONE COMPANY, New York, capital stock $360,000,000, has been organized, with Thurlow Weed Barnes, of New York, president, Gen. Jas. S. Clarkson, John D. Laittre, Chas. R. Pillsbury, Judge Poindexter Dun, E. S. Johnson, Gen. Felix Agnus and others as directors.

THE MUTUAL AUTOMATIC TELEPHONE COMPANY, New York, has been incorporated with J. Wesley Allison, president, and Silas B Dutcher, Smith M. Weed, W. Seward Webb, David A. Boody, Henry N. Whitney, John Jacob Astor, John C. McGuire and Chas. F. Cox, directors. The capital stock is $6,000,000.

THE GLOBE ELECTRIC CONSTRUCTION COMPANY, New York, capital stock $20,000, has been formed to sell and install electric equipment, apparatus and appliances, etc. J. J. Clark, T. F. Coon, of New York; H. C. Mackenzie, of Roseville, and P. M. Mowrey, of Upper Montclair, N. J., are the promoters.

THE DENISON STREET AND ELECTRIC RAILWAY COMPANY, Denison, Tex., capital stock $50,000, has been incorporated to construct and operate street railways or belt lines of railway in or near Denison, etc. The promoters are A. F. Platter, G. McLoger, P. H. Robin, T. Murphy, and E. H. Lingo, of Denison, Tex.

THE ATLANTIC COAST ELECTRIC RAILWAY, Asbury Park, N. J., capital stock $1,000,000, has been formed to construct and operate a street railway or traction company. Wm. H. Hurst, 238 Central Park, West; John J. Walsh, 6 East 93d street, and Henry Haggerty, 137 East 71st street, all of New York, are the interested parties.

THE MANHATTAN INCANDESCENT LIGHT COMPANY, Gloucester City N. J., capital stock $500,000, has been formed to manufacture, buy and sell Welsbach and other incandescent lights and burning devices. Waldron Shapleigh, Camden, N. J., Thos. Dolan, Randal Morgan and C. R Collins, Philadelphia, are interested.

THE SEATTLE & ALASKA MINING AND MILLING COMPANY, Seattle, Wash., capital stock $250,000, has been formed to mine and market ores of precious metals, do logging, lumbering, etc., and to erect and maintain water and electric power. Wm. M. Ebner, W. E. Crews, J. E. Fox, W. D. O'Toole and P. F. Smith are the incorporators.

THE EMPIRE STATE ELECTRIC FORGING COMPANY has been formed at Syracuse, N.Y., with a capital stock of $300,000, for the purpose of manufacturing, selling and operating electric welding, forging and smelting apparatus. L. H. Groesbeck, C. M. Varner, of Syracuse; J. O. Adsit, Hornellsville, and D. E. Mosely, Rochester, N. Y., are interested.

THE TACOMA GAS AND ELECTRIC LIGHT COMPANY, Tacoma, Wash., capital stock $350,000, has been formed to supply gas and electricity for light and other purposes, and to operate water works, railways, vessels, etc. Edmund Seymour, Chas. B. Hurley, C. P. Masterson, Alfred E. Buell, Frederick Watson, W. C. Hellar and Jno. F. Dillon.

THE FELTS PRIMARY BATTERY COMPANY, Sacramento, Cal., capital stock $1,000,000, has been formed to purchase, lease, operate or dispose of all kinds of electrical rights, patents, licenses, batteries, machinery, apparatus, and other property pertaining to electric lighting. W. W. Felts, R. Watkins, Thos. E. Pogalsang and G. W. Merrell, Sacramento, Cal., are the interested parties.

Telegraph and Telephone.

NEWPORT, KY.—The Anthony Electric Company will establish a telephone system.

KANSAS CITY, KY.—B. F. Jones is organizing a company to construct a telephone system.

UTICA, N. Y.—The Central New York Telephone Company will put in new telephone apparatus.

BURLINGTON, N. C.—Steps are being taken looking to the establishment of a telephone exchange.

MEMPHIS, TENN.—L. E Drake, of Anderson, Ind., is endeavoring to form a telephone exchange.

SPRINGFIELD, MO.—The telephone line from Ozark to Springfield is expected to be in operation May 1.

LE FEVER FALLS, N. Y.—The West Shore Telephone Company is erecting poles for the main line to Kingston.

ABILENE, TEX.—The Abilene Telephone Company will commence the construction of its telephone system at once.

SALISBURY, N. C —C. N. McAddo, of Greenboro, has purchased the telephone system, and will improve the service.

ALBIA, IA.—The Harrison Telephone Company has been granted a franchise and work is to be commenced in a few days.

OWENSBURG, KY.—Steps are being taken to establish a company to operate a telephone system. R Monarch is interested.

SPRINGFIELD, MO.—The Christian County Telephone Company will construct a telephone line from Ozark to Springfield.

ORANGE, C H, VA.—The Interstate Telephone & Telegraph Company, of Durham, N. C., will erect a telephone exchange.

GORDONSVILLE, VA.—The Interstate Telephone & Telegraph Company of Durham, N. C., will erect an exchange for a telephone system.

PARIS, KY —The Paris Telephone Company desires bids on telephone, switchboard and line supplies. Address H. H. Roberts, secretary.

MOBILE, ALA —The Home Telephone Company is putting in a telephone exchange, and has 450 subscribers booked, with three-year contracts.

TUNKHANNOCK, PA.—A telephone line will probably be constructed between Tunkhannock and Meshpoen, by way of Eatonville and Mehoopany.

MOBILE, ALA.—The Home Telephone Company, recently organized, has elected H. Piser president, Jas. K. Glennon vice-president, and W. H. Fitzpatrick secretary.

CHATTANOOGA, TENN.—The Citizens' Telephone Company is to be organized by F. I. Stone, W D Carswell, T. R Preston and others, to construct a telephone system.

SHREVEPORT, LA.—The Citizens' Co-Operative Telephone Company, of which John W. Taber is manager, is successfully pushing forward the completion of this new company.

TALLAHASSEE, FLA.—Address the Capital City Telephone Company, M. B. Rice, superintendent, concerning bids on 40 telephones and apparatus for an exchange of 50 subscribers.

THE ERIE TELEGRAPH & TELEPHONE COMPA NY made a net gain of 291 subscribers for the three months ending March 31. Total number connected March 31, 1895, 16,465.

SALISBURY, MD.—The Wicomico Telephone Company has been granted a charter to erect a telephone line from Salisbury, Quantico, White Haven, Naticoke, Tyaskin, Bivalve and other villages.

ALEXANDRIA, VA.—The Occoquan Woodbridge Telephone Company, K. S. Wyckoff, vice-president, has secured a building in which the office of the company will be located, and will soon commence the construction of the line.

ST. LOUIS, MO.—The Central Standard Telephone Company, of St. Louis, Kansas City and Lincoln, is being organized by Griffith Colt, president of the Union Trust Company, of St. Louis, and others. The capital stock is $5,000,000.

TAMPA, FLA.—The Citizens' Telephone Company, with a capital stock of $12,000, which was recently organized, with S. J. Drawdy, president; A. C. Clewis, vice-president; C. H. Keller, secretary and manager, expects to have its line in operation within 90 days.

MYERSTOWN, PA —The Daniel Drawbaugh Telephone & Electric Company has secured a building for the location of a telephone instrument factory, which will have a capacity of 50 instruments daily, and give employment to 50 workmen. Subscriptions amounting to $10,000 have already been raised.

MANASQUAN, N. J.—The Manasquan Telephone Company has installed a small exchange, using Gerson telephones and switchboard. The exchange is to be connected with one in Point Pleasant, N. J., by toll line, and later will connect with Spring Lake, Asbury Park and Freehold, and probably with Lakewood.

LOUISVILLE, KY.—The Southern Standard Telephone Company is to be organized to operate in Kentucky, Tennessee, North Carolina, and South Carolina. It is to be a branch of the new Standard Telephone Company, of New York, of which Thurlow Weed Barnes is president, and is to have a capital stock of $4,000,000.

NEW ORLEANS, LA.—The New Orleans branch of the new Standard Telephone Company of which Thurlow Weed Barnes, of New York, is president, has organized as the Gulf States Standard Telephone Company, with A. Maginnis as president, W. J. Behan, vice-president, and Harry Allen, general manager. This company will control Louisiana, Mississippi, Alabama, Georgia and Florida.

ELECTRIC LIGHT AND POWER.

BARTON, VT.—An electric light plant is being placed in position.

ALEXANDRIA, LA.—An electric light plant has been established.

STATESBORO, GA.—W. D. Davis will erect an electric light plant here.

GEORGETOWN, S. C.—Steps are being taken to establish an electric ligh plant.

BOWIE, TEX.—John Graves, of Henrietta, is putting in an electric lighting plant.

LA GRANGE, TEX.—Baylor & Bradshaw have purchased the city's electric light plant.

READSBORO, VT.—Steps are being taken to establish an electric light and power plant.

NEW YORK CITY.—An electric lighting system is to be installed in the custom house.

SARATOGA, N. Y.—The Saratoga Gas & Electric Light Company's plant is to be sold May 28.

BIRMINGHAM, ALA.—An electric plant will be built to supply power to manufacturing concerns.

TAYLOR, TEX.—The Taylor electric light plant has been purchased at a foreclosure sale by B. Garry for $10,975.

WESTERLY R. I.—The establishment of an electric plant here is contemplated. Address the clerk of the Council.

GOFFSTOWN, N. Y.—A bill has been introduced authorizing the village to build and maintain an electric lighting plant.

NORWICH, CONN.—The establishment of a municipal electric light plant is contemplated. Address the clerk of the Council.

CANANDAIGUA N. Y —The Canandaigua Electric Light Company has been granted the right to operate in Wayne and Ontario counties.

POELOUSAS, LA.—It is reported that bonds are to be issued for the erection of an electric lighting plant. The Mayor can furnish details.

IPSWICH, MASS.—The street lighting system is to be extended in the near future. The town clerk can be addressed for further information.

CLYDE, N. Y.—Franchises have been applied for by the Clyde Electric Light Company to build, operate and maintain an electric light plant.

ELDORADO SPRINGS, MO.—W. B. Lewis and others have been granted a franchise to erect an electric light plant to be operated within two years.

READSBORO, VT.—The Hoosac Electrical Power Company is being organized, with a capital stock of $100,000, for the purpose of developing water power.

ENTERPRISE, MISS.—A franchise has been granted L. B. Bradley, of this place, and S H. Gelbanan, of Springfield, Ill., for an electric lighting plant.

MARIETTA, GA.—The entire plant and franchise of the Marietta Electric Light Company is to be sold May 7 to satisfy a mortgage indebtedness of $3,000.

SOUTH FRAMINGHAM, MASS.—It is reported that Messrs. Gregory, Shaw & Co are contemplating the erection of an electric lighting plant in their factory.

HASBROUCK HEIGHTS, N. J.—An appropriation has been requested for the lighting of the streets. The clerk of the borough Council can furnish particulars.

BELLEFONTAINE, O.—$15,000 in bonds are to be issued for the purpose of lighting the city with electricity. Address the clerk of the Council for further particulars.

HAMILTON, ILL.—It is reported that a municipal electric lighting plant is to be established here in the near future. J. A. Borden, city clerk, can be addressed for details.

WANNESBORO, VA.—It is reported that an electric lighting plant is to be established here in the near future. P. H. Antrim and W. N. Fishburn are among those interested.

AUBURN, N. Y.—It is reported that an electric lighting plant is to be established here in the near future. The clerk of the Council or Mayor Lewis can be addressed for detailed information.

ATHENS, GA.—The Tallahassee Shoals Electric Company will be chartered, with a capital stock of $50,000, for the purpose of developing the water power of the Tallahassee shoals and transmitting the same electrically.

WEBB CITY, MO —A complete municipal electric light plant is to be established in this city in the near future. The most modern electrical machinery will be introduced, and the clerk of the Council can be addressed.

BUFFALO, N. Y.—The new office building to be erected on Franklin, near Chippewa street, is to be lighted by electricity. The structure will be fireproof, and all modern improvements will be introduced. Address J. L. Kuller.

PHILADELHPIA, PA.—The installation of an electric light plant in the city hall court yard is contemplated for the purpose of lighting the streets and publi buildings with electricity. Address the clerk of the Council for details.

GEO. F. WOOLSTON, 40 Wall street, N. Y., will receive offers for the supply of a 450 arc lighting plant for Hudson County, N. J., and for a 150-arc and 2,000 incandescent lighting plant for Kearney Township, Hudson County, N. J.

MANHATTAN BEACH, L. I., N. Y.—An electric lighting system is to be installed in the music amphitheatre owned by the Manhattan Beach Hotel & Land Company, 11 John street, New York City, at this place. The secretary of the company can be addressed for particulars.

WILLIMANTIC, CONN.—Work will be commenced as soon as the plans have been prepared on the erection of the proposed city hall, which is to cost $60,000. W. R. Briggs, 238 Main street, Bridgeport prepared the plans, which call for all modern improvements, including electric lighting.

THE ELECTRIC RAILWAY.

BURLINGTON, VT.—An electric road is being built from Winooski to Essex Junction.

ROSSVILLE, TENN.—An electric railway line is to be built from Rossville to Chickamauga Park.

DENISON.—Steps are being taken to establish an electric railway. P. H. Tobin and A. F. Platter are interested.

KANSAS CITY, MO.——The steam road from this city to Independence is to be equipped with the electric trolley system.

NEW HAVEN, CONN.—A line is to be built from this place to Hamden Plains Church. Address the clerk of the Council for details.

MORRISTOWN, N. J.—Permission has been granted the Morristown Electric Company to erect poles and string wires on Hill street.

COLUMBIA, PA.—Work will be commenced in the near future on the construction of the Columbia, Mt. Joy & Ironville Railway.

PASS CHRISTIAN, MISS —A 50-year franchise has been granted Maurice Kaufman, of New Orleans, for an electric lighting plant.

HAGERSTOWN, MD.—The construction of an electric street railway in this city is contemplated. Address Mayor Keedy for further information.

CHATTANOOGA, TENN.—The construction of a railway from this city to Augusta, Ga., is projected. C. W. Howard is among those interested.

ST. LOUIS, MO.—The King's Highway Railway Company has secured a charter to build an electric line along the thoroughfare of that name.

NEW YORK.—It is reported that the New York & Greenwood Lake Railway is to be operated by electricity. Abram S. Hewitt can be addressed for details.

WILLIAMSTOWN, MASS.—Right of way has been applied for by the Hoosick Valley Street Railway Company to extend its line from North Adams to this place.

BROWNSVILLE, N. Y.—A franchise has been granted by the village authorities for the proposed extension of the electric railway. Address the village clerk.

HOUSTON, TEX.—O. M. Carter may be addressed regarding the extension of the Houston Rapid Transit Company's trolley system to the race course in the suburbs.

EASTLAKE, LA.—It is reported that the new electric street car line will be extended to connect with the Bradley-Ramsay tram road several miles north of the city.

ATHENS, GA.—The Athens Street Railway Company has purchased the Mitchell's bridge property, and will convert its magnificent water power into electricity.

GREENBUSH, N. Y.—The Electric Railway Company has applied for a franchise to construct an electric railway. A. Barnes is at the head of the enterprise.

PITTSBURGH, PA.—The Oliver Iron & Steel Company will build an electric railway on Bingham street. For further particulars address the secretary of the company.

ALBANY, N. Y.—Plans have been prepared for the enlargement of the power house of the Albany Railway, to cost $50,0000. A 1,000-hp boiler and generator will be installed.

SANFORD, FLA.—J. M. Saunders and others have been granted a franchise to build and maintain an electric street railway; it also allows the privilege of lighting by electricity.

LOCKPORT, N. Y.—Charles A. Johnson, of New York City, has been granted a franchise to extend the Lock City Electric Railway. The secretary can be addressed for particulars.

POINT PLEASANT, N. J.—The South Jersey Street Railway Company intends building to Bay Head from Point Pleasant, and will have its extension ready for operation by June 1.

MT. MORRIS, N.Y.—Surveys have been made by the B.R. & P. Railway for the extension of the Silver Lake Railway to this place. The secretary of the road can be addressed for detailed information.

POTTSVILLE, PA.—The Town Council has granted the Schuylkill Electric Railway Company an extension of time in which to complete its road. R. H. Verner, town clerk, can be addressed for detailed information.

AUBURN, N. Y.—The Auburn City Railway Company has applied for permission to construct, operate and maintain an electric street railway on certain streets of this city. Orlando Lewis is interested, and can be addressed.

FORT WORTH, TEX.—It is reported the Dallas & Oak Cliff Electric Railway Company, will extend its road from Dallas to this place as soon as right of way can be secured. Henry C. Scott is president and A. P. West, secretary.

DEVON, PA.—The Devon & Berwyn Railway Company has been incorporated with a capital stock of $8,000. The purpose of the company is to build an electric railway between the points named. Address the secretary of the company.

CHICAGO, ILL.—The Chicago & Worth Electric Railway Company, capital stock $2,000,000 is soliciting a franchise covering 28 miles of streets on the west side. It is said that the enterprise is being backed by Mrs. Hetty Green.

DANVILLE, PA.—The construction of an electric railway at this place is contemplated by the North Susquehanna Transit Company. A franchise has been applied for, and the secretary of the company can be addressed for detailed information.

MUNCY, PA.—A company has been organized for the purpose of building a trolley line, nine miles in length, between this place, Hughesville and Picture Rocks. Senator John J. Coyle and Congressman Charles M. Drummare are among the incorporators.

HARTFORD, CONN.—Judge Hall has decided that "public convenience and necessity require the construction of the proposed extension" of the trolley line between this city and Berlin, and the street railway company is, therefore, free to proceed with the work.

TERRE HAUTE, IND.—It is reported that the Crawford Coal Company of this place will prepare plans for the construction of a railway, 60 miles in length, in Fentress County, Tenn., to connect with the Cincinnati Southern system. The estimated cost is $1,000,000.

LAKE CHARLES, LA.—The Lake Charles Railway Company has been organized with a capital stock of $100,000, for the purpose of building a road at this place. The work of construction will be commenced within six months. G. A. Jahn, of New York, is president, R. H. Mason, of Lake Charles, vice-president, and H. B. Milligan, secretary.

JACKSONVILLE, FLA.—A bill has been introduced providing for the incorporation of the Jacksonville & Tampa Bay Railway Company, capital stock $2,000,000. It is proposed to build an electric railway between the points named via Sanford and Kissimmee City. C. C. Thompson, M. Dodge and T. J. Appleyard are among the incorporators.

MISCELLANEOUS NOTES.

MR. EDWARD R. GRIER, of the firm of Grier Bros., Western representative of the Bryant Electric Company, was married to Miss Lucy Parthenia Bosworths of Lee, Mass., on April 16, 1895. After a short trip Mr. and Mrs. Grier will return to Chicago.

PHILADELPHIA ELECTRICAL CLUB.—An electrical club is being formed in Philadelphia, Mr. Frank H. Stewart and Mr. Geo. Vallee being leaders in the movement. It will be composed of representative members of the supply business, electrical engineers, and others identified with central stations and isolated plants. In addition to the purely social purpose of the club, it is proposed to have lectures and formal discussions of current electrical topics of importance.

THE BROOKLYN ELECTRICAL SOCIETY will give its first anniversary dinner and "Trolley-Ho" party on Thursday evening, April 25, at the Albemarle Hotel, Coney Island. The large "Trolley-Ho" car of the Coney Island & Brooklyn Railway has been chartered for the occasion, and will leave the power house at Smith and Ninth streets, Brooklyn, at 7.45 p. m. The society has recently opened a reading room at 370 Pearl street, and is in a very satisfactory condition.

THE TELEGRAPHIC HISTORICAL SOCIETY OF NORTH AMERICA will hold its first regular annual meeting May 1, 1895, in the Board of Trade rooms, 1,410 G street, N. W., Washington, D. C. The first session will open at 10 a. m., when the routine business will be transacted. At a later session, in the afternoon or evening, formal papers will be read and discussed. An address will be delivered by President Cornell, and papers on interesting subjects will be presented by members of the Society. An exhibit of telegraphic relics, rare books, portraits, etc., will be made.

ELECTRICAL ENGINEERING AT THE UNIVERSITY OF WISCONSIN.—The announcement of the course of electrical engineering for 1895-96 at the University of Wisconsin, with respect to its purely technical features, is as follows, the course being in charge of Prof. D. C. Jackson, Asst. Prof. S. B. Fortenbaugh, and Instructor J. G. D. Mack.

1. Electromagnets and Dynamos.—A discussion of the simple forms of electromagnets; the development of the laws of magnetization by electric currents; the laws of simple magnetic circuits and the windings of electromagnets; the practical design, construction and testing of dynamos. 2. Applied Electrochemistry.—(a) Primary and Secondary Batteries. Batteries as a source of electricity; construction and working of primary and secondary batteries, and their commercial use. Comparative and efficiency tests of various commercial types of batteries are made by the students in the laboratory. (b) Electrolysis and Electrometallurgy. The theory and application of electrolysis and electrometallurgy. The treatment of ores, electrolytic separation and refining of metals, electrotyping and electroplating are treated from the practical side 3. Electrical Testing.—Treats of the construction, testing, maintenance, and operation of lines and appliances used in telephony, telegraphy and electric signalling. 4. Theory and Application of Alternating Currents.—The theory of the generation and utilization of alternating electric currents; the design and construction of alternating current dynamos, transformers and motors, and methods for testing alternating current machinery. 5. Electric Light and Transmission of Power.—A study of the manufacture and use of arc and incandescent lamps; selection and arrangement of electrical machinery for generating plants; location, erection and cost of distributing lines, and application of electric motors to the general purpose of power distribution. 6. Electricity in Engineering Operations.—(a) Electric Railways. The roadbed, rolling-stock, electric circuits and power plants for city, town and suburban railways; the location and construction of street railways in cities and towns; track foundation and types of rail; selection of cars and motors to be used under different conditions; methods of conveying the electric current from the generator to the motors, and the best methods for meeting the severe conditions imposed on electric railway power plants. (b) Electricity in Mining and Quarrying. A discussion of the practice in mining and quarrying where electricity can be satisfactorily applied and the advantages and limiting conditions of long-distance transmissions of power by electricity from water power to mines. (c) Station Management and Estimates. The effect on operating expenses of the arrangement of power and generating plants and circuits, and the use of meters. Estimating costs of power and generating plants, and the cost of lines and weights of copper. 7. Graduate Work.—Advanced work as assigned after consultation. Laboratory work.—All laboratory instruction is made to conform with, and illustrate, the class room instruction. Of the total number of hours given to instruction in the electrical engineering courses, about one-half is devoted to work in the laboratories. Students are advised to use their extra time in additional work in the shops and laboratories. An opportunity will be afforded students to take surveying as an elective study.

Trade and Industrial Notes.

I. S. SPENCER'S SONS, of Guilford, Conn., are sending out copies of their 1895 catalogue, which embraces bronze push-buttons of every practical size, shape and finish, bronze name plates, gas attachments, etc

THE LUDLOW VALVE MANUFACTURING COMPANY Troy, N. Y., has published a new catalogue, which is unusually well gotten up. The typographical work and quality of paper are greatly superior to what is ordinarily found in trade catalogues.

THE ELSON & BREWSTER ENGINEERING COMPANY, electrical and mechanical engineers and contractors, have removed their offices from 143 Liberty street, Central Building, to Room 510, Thames Building, corner Greenwich and Thames streets, two blocks below Liberty street.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is again out after the lightning arrester business with the swinging ball lightning arrester, which has made such an excellent record during the past five years. Prices have been very much reduced, and a large business is looked for during the present season.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., is furnishing the iron roof trusses and purlins for the new electric light station at Marblehead, Mass., and has received an order from the Clyde Steamship Company for its new pier shed. The building is 344 feet long and 124 feet wide, entirely of iron.

THE ELECTROSE MANUFACTURING COMPANY, 216 William street, New York, is meeting with much success in the introduction of "Electrose," whose

use for telephones and electrical fittings is rapidly extending. Mr. Louis Steinberger, president of the company, is the inventor of this new substitute for rubber.

THE HALL SIGNAL COMPANY, 80 Broadway, New York, has published an elaborate and beautifully executed catalogue describing the Hall automatic electric block system. Every detail of the system is fully explained and illustrated, down to the most minute particulars, and the whole make-up of the book is thoroughly tasteful and attractive.

THE INDEPENDENT ELECTRIC COMPANY, Chicago, reports a marked effect from its recent reduction in the price of its well-known brand of fuse wire and links. The convenient and attractive manner in which the wire is packed is an indication of the thought bestowed on every detail, and which has resulted in placing the brand at the head.

J. H. McFARLAN & COMPANY, Flint, Mich., are meeting with much success with their new telephone. A report in a local paper states that in a recent exhibition, conversation could readily be carried on with the person speaking 12 feet distant from the transmitter, while a prominent member of the city government vouches for the fact that he carried on a conversation standing 18 feet away from both receiver and transmitter.

THE B. F. STURTEVANT COMPANY, Boston, in catalogue No. 81, describes the Sturtevant automatic upright engine for electric lighting and other high grade work. The numerous cuts thoroughly illustrate the engine, and in a manner that will enable the engineer to readily understand all of its technical features. Nine of the cuts show the engine direct-connected to various types of dynamos, from which its good points for this use can be readily appreciated.

A CORRECTION.—The item which appeared in last week's issue under New England Notes, to the effect that Bibber, White & Co., of Boston, were agents for the Columbia incandescent lamp and the Wagner Electric Manufacturing Company was an error. These companies have jointly opened offices and storerooms at 620 Atlantic avenue, Boston, and have appointed Mr. Chas. E. Bibber New England manager, who will devote his time looking after the interests of these two progressive enterprises.

THE FUEL ECONOMIZER COMPANY, of Matteawan, N. Y., reports business improving, and the works at present very busy. Orders have been obtained for economizers of 2,500 hp for the New Jersey Consolidated Traction Company; 750 hp for the St. Charles Street Railway Company, New Orleans; 2,000 hp for the Detroit Street Railway Company; 800 hp for the Holyoke Street Railway Company; 1,000-hp for Howland Crofts & Son, Camden, N. J., and 2,400 hp for the Crystal Plate Glass Company, St. Louis.

THE HAYDEN & DERBY MANUFACTURING COMPANY, 111 Liberty street, New York, in a 32-page pamphlet entitled "Practical Information about Injectors," give some plain facts in connection with various forms of injectors sold by it, which will be of interest to all steam users. The information gives the range of the Metropolitan injector under the various conditions found in practice, including extensive tables of capacities. Full directions for connecting, operating, etc., are given, with other information that will be appreciated by users.

A. KLIPSTEIN & COMPANY, 122 Pearl street, New York, whose "Electric" brand of sal ammoniac has been so favorably known to the telephone and battery trades for two or three years, report a better demand than ever before. The importance of having pure materials specially adapted for their respective uses is becoming more and more generally realized in electrical industries, and the efficiency and durability of batteries being very largely dependent upon the purity of the sal ammoniac used in them, the necessity of using a good grade is apparent.

THE MORTON MANUFACTURING COMPANY, Muskegon, Heights, Mich., in a 40-page catalogue describes its extensive line of portable and stationary key seating and key making machinery, portable planers and universal draw-cut shapers. The many illustrations of machines are accompanied by unusually complete technical descriptions, a valuable feature, unfortunately too often missing from trade catalogues. The award made to this firm at the Chicago Exposition is signed by Prof. W. C. Unwin, which puts the technical merit of the machines beyond question.

THE NEW JERSEY ASBESTOS COMPANY, 117 Front street, Camden, N. J., has issued a handsome large page catalogue with an illuminated front cover, devoted to its many manufactures of asbestos. Among these are included high pressure steam packings, boiler and flange gaskets, pipe coverings, asbestos cloth, tubing, roofing, etc. Among the novelties are "Salamander" asbestos decorations in relief for the interior decoration of buildings, "Gladiator" asbestos aprons and gloves, and "Asbestolio," a cleaning and polishing powder particularly recommended for use about machinery.

ELMER G. WILLYOUNG & COMPANY 1,210 Betz Building, Philadelphia, Pa., have made an arrangement with the Anchor Electric Company, of Boston, by which the latter becomes the New England agents for the sale of "Iron Clad" ammeters and voltmeters. Large numbers of these instruments are being sold all over the country, and there has been some difficulty in supplying orders, so great has been the demand. For alternating currents in particular, the instrument is much in demand, as it is practically the only instrument there is at such a reasonable price.

THE HOPPES MANUFACTURING COMPANY, Springfield, O., has recently opened a branch office at 512 Security Building, St. Louis, Mo., in order to better handle the rapidly increasing business in that territory for its well-known live steam feed-water purifiers and exhaust steam feed-water heaters. Mr. A. W. Remnitz, long known to the steam users of St. Louis, will have charge of this office. The company reports as among some of its recent shipments of feed-water purifiers the following: Nordyke & Marmon Company, Indianapolis, Ind., one 300-hp. and one 150-hp; Indianapolis (Ind.) Abattoir Company, 300-hp; Butters & Peters salt & Lumber Company, Ludington, Mich., 1,000-hp; for the new shape mill of the Johnson Company, at Lorain, O., 3,350 hp; Rosengarten & Sons, Philadelphia, Pa., 200-hp; New York Tartar Company, New York City, 1,000-hp; The Hudnut Company, Terre Haute, Ind., 250 hp; Detroit (Mich.) Citizens' Street Railway Company, 2,000-hp; Hamilton (Ohio) Electric Light Plant, 400-hp; Crystal Ice & Cold Storage Company, Anderson, Ind., 300-hp; Ætna Ind.) Powder Company, 100-hp.

Business Notice.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED March 26, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

537,464. PRINTING TELEGRAPH; O. L. Kleber, Pittsburgh, Pa. App. filed June 5, 1894. A printing telegraph machine, consisting of a type wheel, a toothed spacing wheel, a number of tooth selecting discs, and means for simultaneously rotating the wheels and discs in the same direction, in combination with an electromagnet, an armature bar, and pivoted finger for controlling the rotation of the spacing wheel, said finger being adapted to release the selecting discs by a downward pull of the armature bar, and resume its former position.

537,474. App. filed Jan. 7, 1893; 537,475, app. filed Aug. 2, 1894. SECONDARY BATTERY. William M. McDougall, East Orange, N. J. A storage battery with a perforated box containing an electrode and provided with vertical spacing ribs on the exterior on one wall.

537,480. COMMUTATOR; G. E. Painter, Baltimore, Md. App. filed Feb. 28, 1895. A commutator with a series of base bars suitably mounted and insulated from each other, and a series of contact shoes or bars, seated upon the said base bars being insulated from each other and a clamping device common to all of the contact bars or shoes for confining them in their proper place and maintaining them in electric connection with the base bars.

537,498. INCANDESCENT ELECTRIC LAMP; E. Thompson, Swampscott, Mass. App. filed May 23, 1892. An incandescent lamp having a screw-thread formed on the material of the exhausted chamber of the lamp and insulated terminals combined with a socket having enclosed insulated terminals adapted to make spring contact with the other terminals, with an outside covering insulated from all of the terminals, and 537,500, filed same date, and 537,501, filed same date.

537,499. ELECTRIC MEASURING INSTRUMENT; E. Thompson, Swampscott Mass. App. filed Oct 26, 1894. An electric measuring device having a pair of magnets whose poles are of unlike signs opposed to one another, also a compound coil composed of other similar coils which are hollow, laid side by side or in the same plane rotating in the field of the magnets against an opposing force.

537,513. COMBINED CUT-OUT AND LIGHTNING ARRESTER; M. J. Wightman, Scranton Pa. App. filed Jan. 9, 1895. A lightning arrester having a line circuit, cut-out terminals, lightning arrester terminals and an electro-magnet in the line circuit having a pole of the same sign under each of the sets of terminals, and the two poles provided with a common armature.

537,515. ELECTRIC SWITCH; J. J. Wood, Fort Wayne, Ind. App. filed Nov. 12, 1894. An electric switch having a rotating bridge, a rotative axial spindle, an operating handle, a spring interposed between the bridge and spindle, a stationary ratchet, and a two armed pawl connected to the bridge, with its arms projecting to opposite sides of the spindle with an operating arm projecting from the spindle between said arms of the pawl and adapted to bear against either.

537,533. ELECTRIC SWITCH; E. M. Hewlett, Schenectady, N. Y. App. filed Dec. 22, 1894. A reversing switch with a set of contacts, switch blades normally held in contact therewith by means of a spring, and a second set of contacts adapted to engage the switch blades when the feeder switch is thrown.

537,538. ELECTRIC SWITCH; A. Metzger, Schenectady, N. Y. App. filed Oct. 5, 1892. A switch for electrical currents consisting of a terminal clip formed of a single piece of metal having an extension folded upon itself and provided with screw-threaded holes and projecting beyond the insulated base, one of the circuit terminals having pivoted thereto a switch blade and the other formed with a vertical projection integral therewith and serving as a stop for the switch blade when in contact with the circuit terminal.

537,539. ELECTRIC SWITCH; A. Metzger, Schenectady, N. Y. App. filed April 15, 1893. The description of this is the same as the preceding one.

537,541. REGULATOR FOR DYNAMO ELECTRIC MACHINES; W. S. Moody, Boston, Mass. App. filed Aug. 30, 1893. The combination with a switch, a system of exciter dynamo machines, a lever adapted to operate the switch, a coil in shunt to the main circuit adapted to repel the lever and move it in the desired direction when the line potential becomes too great, an adjustable restoring device for the lever, a coil in series with the main circuit and a core for the series coil whereby the effect of said coil on the lever may be varied.

537,555. FILAMENT AND CARBON FOR ELECTRIC LAMPS; P. Stiens, London, England. App., filed Feb. 14, 1895. A process of treating filaments or carbons in the course of manufacture, which consists in boiling them in burned boric acid, and then heating them by the electric current in the presence of carbonaceous vapor or gas.

537,575. GLASS VESSEL FOR SECONDARY BATTERIES, etc; H. Kroeker, Berlin, Germany. App. filed April 22, 1893. A vessel having two internal walls provided with parallel grooves extending to the bottom of the vessel and formed with projections or shoulders on their tops.

537,595. ELECTRICAL INTERRUPTER; G. J. Anderson. App. filed Feb. 18, 1895. An interrupter mounted on a shaft run by power, the combination of a number of insulated segments with a brush through which the current is introduced, metal rings in such a number as allows division of the segments, metal screws connecting electrically the metal rings with the segments, and a number of brushes, each of which presses against one metal ring.

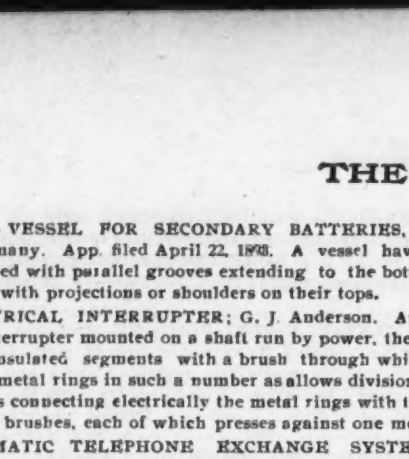
537,608. AUTOMATIC TELEPHONE EXCHANGE SYSTEM; W. Decker, Owego, N. Y. App. filed May 14, 1894. The combination consisting of parallel conducting rods and radial arms, ratchet wheels carrying each one of the radial arms which are long enough to come in contact with the conducting rods, the ratchet wheels being independently rotary upon an insulated rod, and electromechanical devices for operating the respective ratchet wheels, for the purpose of bringing two or more of the radial arms in connection with one rod.

537,617. ELECTRIC ARC LAMP; C. A. Pflunger, Chicago, Ill. App. filed July 2, 1894. The combination of a carbon holder with a carbon free to move therein, a lever pivoted to a standard and adapted to engage pins projecting from the carbon holder, a shunt magnet, and a series magnet each having its core attached to one end of lever and a lower carbon attached to a movable frame and provided with detaining points.

537,626. ELECTRIC RAILWAY CONDUIT SYSTEM; H. A. Belden, Washington, D. C. App. filed Jan. 26, 1895. The combination of a conductor support comprising a screw-threaded support, a bracket formed with a seat in its end face to hold the conductor, and having both vertical and lateral adjustments on the screw-threaded support, adjusting nuts above and below the bracket to adjust it vertically, and a conductor having a flange bolted to the projecting portion of the bracket.

537,680. ELECTRIC RAILWAY CONDUIT SYSTEM; A. N. Connett, Washington, D. C. App. filed Jan. 26, 1895. The combination of a slotted rail frame adjacent to it formed with a chamber, a conductor holding device, comprising an outer shell detachably seated in the chamber, and having its lower edge formed with an upward incline, a holder of non-conducting material in the casing and a stem insulator, adapted to sustain a conductor in the conduit.

537,638. ELECTRIC ARC LAMP; E. H. Crosby, Boston, Mass. App. filed Aug. 13, 1894. An arc lamp having two diagonally arranged fixed supports of conducting material with carbons fitted to slide and move laterally in the supports, the free ends of the carbons outside of the supports being normally spring-pushed into engagement with each other; an electromagnet in the circuit of which said supports are interposed, a non-conductive material actuated by the armature of the magnet into engagement with the free ends of the carbons and arranged to consecutively spread the same in opposition to their springs; lock the carbons against gravity movement and feed the carbons toward each other at determined points in the variation of current.



No. 537,475.—Secondary Battery.

537,644. TELEGRAPHY; R. H. Morris, Roselle, N. J. App. filed Aug. 10, 1894. The combination of a neutral relay and a current reversing key at the same station, the neutral relay being provided with oppositely wound coils which are joined, one to the positive and the other with a negative generator.

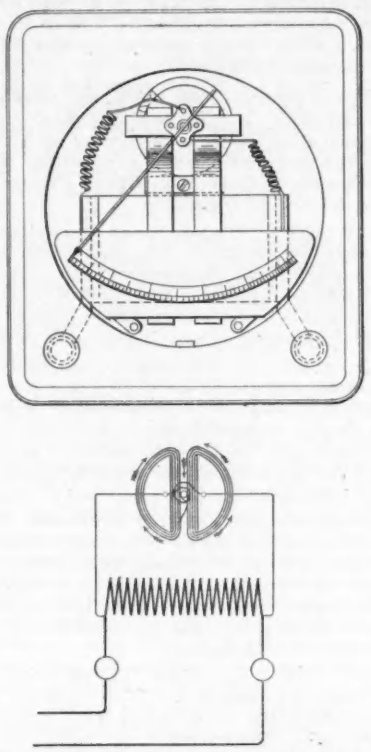
537,665. ELECTRIC SWITCH; H. P. Ball, Bridgeport, Conn. App. filed Oct. 19, 1894. An electric switch having terminals to be connected or disconnected, hinged blades connected by a spring, a pivot bearing in each blade in the form of a circle or sector, a sector of a groove in each blade concentric with the pivotal point, a conducting ring located in the sectors of the circular groove, and means for retaining the ring in position and the adjacent edges of the blades in contact.

537,672. ELECTRIC RAILWAY; J. Claret & O. Wuilleumier, Lyons, France. App. filed Sept. 19, 1894. An electric railway system having sectional conductors with the intermediate insulating parts of insulating blocks arranged transversely upon a beam, such blocks being connected by suitable insulating molten substance which is poured while hot into the joints and forming when cool a compact and rigid body connected with the contacts for the purpose of forming the central rail of the line.

537,673. ELECTRICALLY ACTUATED VEHICLE; J. B. Clark, St. Paul, Minn. App. filed March 8, 1894. A vehicle with the framework mounted to run upon tracks, an axle journaled to it having pulleys upon its ends, rim surrounding the pulleys and running upon tracks, reversely inclined friction rollers supported in a framework and interposed between the rim and the pulleys and means for adjusting the friction rollers, and an electric motor so connected as to be adapted to actuate one of the friction rollers.

537,693. PROCESS OF EVACUATING INCANDESCENT LAMPS; A. Malignani, Udine, Italy. App. filed Aug. 15, 1894. The process for producing a vacuum in the bulbs of incandescent lamps is in first introducing into the tubular elongation of the bulb after the air has been exhausted, various chemicals which form a cement when heated and so seal the bulb

537,698. ELECTRIC ARC LAMP; L. C. H. Mensing, London, England. App. filed Oct. 29, 1894. The combination in an arc lamp of an upper carbon



No. 537,500.—Electric Measuring Instrument.

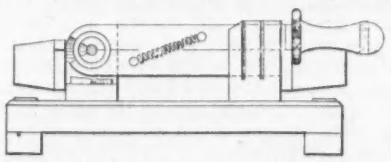
carrier, a swing frame having pivotally supported therein a double or divided wheel composed of a grooved cord pulley and a brake wheel connected by pawl and ratchet mechanism, differential solenoid coils having their cores supported from arms of the swing frame and connected to a band on the brake wheel, and a cord connecting a pulley with a fixed carbon carrier, and a coiled band enclosed in the pulley and having one end attached thereto, and the other end secured to a fixed arbor.

537,706. SECTIONAL CONDUCTOR FOR ELECTRIC RAILWAYS; J. F. McLaughlin, Philadelphia, Pa. App. filed Feb. 5, 1895. The combination with a main or supply conductor and a sectional working conductor, of rotary switches for coupling the same, pivoted armatures for actuating the switches, and traveling magnets passing over the armatures in inductive relation thereto.

537,715. SAFETY SUPPORT FOR OVERHEAD ELECTRICAL CONDUCTORS; A. D Poole, Boston, Mass. App. filed Aug. 13, 1894. A safety support consisting of a frame of conducting material, two studs mounted upon the ends of the frame, an insulating device and discs on the studs, arms of conducting material mounted upon the device and between the discs, insulating blocks between the studs and a raised portion on the arms arranged to form contact with the outer end of the frames.

537,718. ELECTRIC WIRE INSULATOR; D. N. Rothenberger, Lancaster, Pa. App. filed Jan. 8, 1895. An insulator having an external groove adapted to receive the main wire, and an inwardly extending opening having its outer end extending into the said groove, and its inner end enlarged, so a doubled wire may be placed within the said opening and a holding material placed around the doubled portion of the wire, and within the enlarged portion of the opening.

537,757. RAILWAY BLOCK SIGNAL LOCK AND REGISTER; J. Dean, New York, N. Y. App. filed Oct. 26, 1894. A railway block signal lock, comprising a lock bar for the signal lever and provided with teeth, a shaft mounted to turn and under the control of the operator, a toothed wheel on the shaft



No. 537,665.—Electric Switch.

adapted to engage the teeth of the lock bar, and a disc held on the shaft turning with the same, the disc being provided with targets for indicating the position of the mechanism during each revolution of the shaft.

537,769. ELECTRIC METER; H. T. Harrison, London, England. App. filed June 14, 1892. An electric meter comprising a pendulum having a constant rate of vibration, a series coil adapted to increase the amplitude of vibration of the pendulum, and a registering device to record the said increase of amplitude.